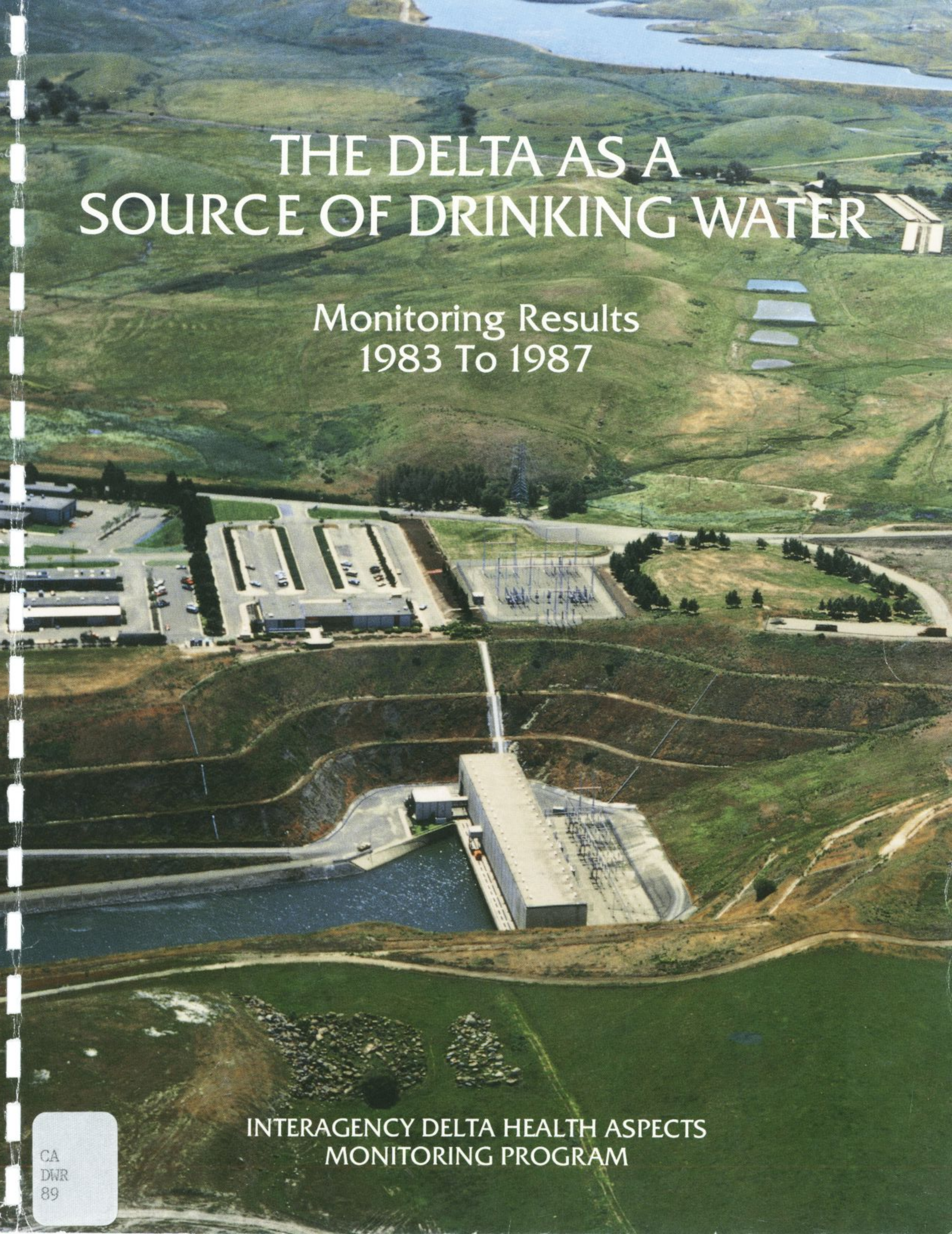

THE DELTA AS A SOURCE OF DRINKING WATER

Monitoring Results 1983 To 1987

INTERAGENCY DELTA HEALTH ASPECTS MONITORING PROGRAM

The Delta as
A Source of Drinking Water

Monitoring Results – 1983 to 1987

INTERAGENCY DELTA HEALTH ASPECTS
MONITORING PROGRAM

Department of Water Resources
Central District **August 1989**

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FOREWORD

Sound water resources management requires comprehensive data collection to enable understanding of factors that can affect water quality. The Department of Water Resources, in cooperation with other water agencies, initiated the Interagency Delta Health Aspects Monitoring Program in 1983 in response to recommendations by a scientific panel appointed by the Director to assess human health aspects of Delta water supplies. Because of their potential effects on human health, the program focuses on the following constituents: sodium, selenium, asbestos, trihalomethane precursors, pesticides, and other synthetic organic chemicals.

The program has evolved into a combination of monitoring and special investigations related to the quality of Delta water supplies. Study priorities are determined and carried out by the Department through the guidance of a Technical Advisory Group, represented by participating water agencies. The Department of Health Services is also represented in the Technical Advisory Group, providing input on human health issues and laboratory quality assurance.

This report presents an analysis of data collected in and near the Delta during the first five years of the program, January 1983 through December 1987. The report also provides an overview of major factors that affect Bay-Delta water quality and identifies water quality considerations for the future.

The Delta is an acceptable source of drinking water, which when treated meets drinking water standards. The ability to meet drinking water standards at treatment facilities depends, in part, on quality of the water being treated and regulatory requirements of the drinking water standards. Compliance with drinking water standards may become more difficult in the future as a result of proposed tightening of the standards.

This program is an integral part of the Department's mission of water resource planning and protection of California's drinking water supplies. This monitoring program will continue to be responsive to health-related water quality concerns identified by the Technical Advisory Group.

Jerry D. Vayder

Jerry D. Vayder, Chief
Central District

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ACKNOWLEDGMENTS

The Department of Water Resources is the lead agency conducting the Interagency Delta Health Aspects Monitoring Program.

Program funding and technical assistance are provided by:

East Bay Municipal Water District
Contra Costa Water District
Urban Water Contractors of the State Water Project
including
Metropolitan Water District of Southern California
Santa Clara Valley Water District
Alameda County Water District
Alameda County Flood Control and Water Conservation District, Zone 7

The Department of Health Services participates in the program through its membership in the Technical Advisory Group, which includes representatives of the other participating agencies.

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SUMMARY

The purpose of the Interagency Delta Health Aspects Monitoring Program, which began in 1983, is to obtain water quality information that will help in making decisions about the quality of water resources and to assess potential water treatment methods. This program is the only one of its kind to provide comprehensive monitoring of human health-related water quality conditions throughout the Sacramento-San Joaquin Delta.

Major factors affecting Delta water quality are:

» Regulatory controls,

» Inflow, tides, precipitation, diversions, and

» Municipal, industrial, and agricultural activities in the Delta and in drainage areas tributary to the Delta.

Results of Water Quality Analyses

Monitoring focuses on constituents that may affect public health: trihalomethane formation potential, sodium, chloride, pesticides, asbestos, trace elements such as selenium, and synthethic organic pollutants. Water quality parameters, such as pH, electrical conductivity, dissolved oxygen, total organic carbon, nutrients, temperature, color, flow, and turbidity, are also measured. Water samples for field or laboratory analyses are collected at various monitoring stations in and near the Delta.

Total Trihalomethane Formation Potential

THM formation is one major issue of concern with regard to continued treatment of Delta water for human consumption. THMs are formed when certain organic substances dissolved in the water combine with chlorine used to disinfect drinking water. THM compounds produced during chlorination include chloroform, dichlorobromomethane, dibromochloromethane, and bromoform. Because of evidence linking THMs to cancer, the U.S. Environmental Protection Agency has established a 100 microgram per liter drinking water standard for THMs. The California Department of Health Services enforces the federal THM standard.

Water containing higher concentrations of THM-forming agents (precursors) generally produce higher concentrations of THMs when treated with chlorine. THM precursors include bromides, contributed by seawater or estuarine water. Bromides are also found in fresh water flowing into the Delta, particularly the San Joaquin River. Bromides from seawater or estuarine water can influence total THM formation potential. Concentrations of bromides in fresh water are similar to those typical in rainfall.

Bromides can raise THM formation potential values significantly because brominated THMs weigh more than chlorinated THMs and can successfully compete with chlorine to form organic compounds. THM compounds containing bromides can be more complicated to control and remove than chloroform (the THM that contains no bromine), and there is concern that the health effects of brominated THMs may be greater than those from chloroform.

This study assesses the relative amount of THM precursor material -- or total THM formation potential (both chlorinated and brominated) -- in untreated Delta water. Five stations have been chosen to represent conditions in various parts of the Delta. The fresh water locations, Sacramento River at Greene's Landing and San Joaquin River at Vernalis, represent water flowing into the Delta. Seawater influences are represented by the Mallard Island station. Export water quality is represented by the Rock Slough (Contra Costa Canal) and Banks Pumping Plant (State Water Project) stations.

Results of total THM formation potential measurements over the 5-year study period are summarized in Figure 1. Median total THM formation potential values at each location are depicted by the sizes of the pies. The shaded slices of the pies show the fraction of the total THM formation potential that is composed of THMs containing bromides, by weight. The unshaded slices show the fraction that contains only chlorine.

Total THM formation potential is small (260 ug/L) at the Sacramento River at Greene's Landing, and the brominated fraction is only 6 percent of the total THMs. The presence of bromides at Greene's Landing can be attributed to weathering of mineral deposits in the Sacramento Valley basin.

In contrast, total THM formation potential at Mallard Island is much larger (900 ug/L); the brominated fraction is 90 percent. Daily tidal excursions and upstream releases affect water quality in this area.

Median bromide levels in the San Joaquin River (30 percent) are also much higher than those in the Sacramento River at Greene's Landing and somewhat higher than for the export water at Banks Pumping Plant (18 percent) and Rock Slough (14 percent). Sources of San Joaquin River bromides are not known; two possibilities are marine sediments in the San Joaquin drainage and bromide-containing Delta water used in San Joaquin agriculture.

To put these numbers in perspective, water taken from the Sacramento River by the City of Sacramento meets the current THM standard without additional treatment, whereas drinking water supplies from the Delta require additional treatment to meet the standard. Water agencies using the Delta as a source of drinking water successfully treat the water to meet the current THM standard.

The THM standard will be revised within two or three years. It is expected to be significantly more stringent, making successful treatment more difficult and expensive. Therefore, sources of THM-forming agents are a subject of great interest.

Sodium

The National Academy of Science has two advisories for sodium: 20 mg/L for people on severely restricted sodium diets, and 100 mg/L for people on moderately restricted diets. There are no federal or State drinking water standards for sodium.

Sodium concentrations of 20 mg/L and above were observed at all stations except American River Water Treatment Plant, Sacramento River at Greene's Landing, and North Bay Interim Pumping Plant.

Sodium concentrations at Rock Slough, Clifton Court, Banks Pumping Plant, and the Delta-Mendota Canal Intake exceeded the NAS advisory of 100 mg/L infrequently, during extremely low flows at the end of the extended dry period in 1987. During most times, sodium levels fell in the 20 to 99 mg/L range, which is safe for most people.

Sodium concentrations exceeded the 100 mg/L criteria 90 percent of the time at the Sacramento River station at Mallard Island, which is heavily influenced by seawater. This location was selected for study because it is influenced by San Francisco Bay. Drinking water supplies are not taken from this location, although Contra Costa Water District has an intake at Mallard Slough, west of Mallard Island. The Mallard Slough intake is used only during periods of high outflow, when mineral quality is good and seawater influence is minimal.

Pesticides

The few pesticide contaminants found in Delta water samples were at concentrations marginally above laboratory detection but considerably below health-based drinking water standards. About 4 percent of the pesticides analyzed were actually detected at or slightly above the detection level. A tabulation of 5-year pesticide monitoring results and a list of pesticide drinking water standards are presented in Chapter 3. Because pesticide concentrations in water were so far below the drinking water standards, pesticide concentrations apparently have no significant impact on use of Delta water for human consumption.

Asbestos

Asbestos concentrations at locations monitored varied from 12 million to 7,500 million fibers per liter of water. One value at the Sacramento River at Mallard Slough of 26,000 million fibers per liter is questionable. The analytical laboratory suspected there may have been a dilution error when the sample was prepared, but was unable to verify the error.

Asbestos concentrations in untreated water bear little resemblance to the concentrations in treated drinking water, because normal treatment processes reduce initial asbestos concentrations by 99 percent or more. Asbestos in treated drinking water of Delta origin rarely exceeds the proposed federal standard of 7.1 million asbestos fibers per liter.

Selenium

During the 5-year study, selenium values never exceeded the state or federal drinking water standard of 10 ug/L at any sampling location. Selenium in Central Valley agricultural drainage discharged into the San Joaquin River is frequently diluted to levels below detection (less than 1 ug/L) downstream of Vernalis.

Salinity, Electrical Conductivity, Ion Concentrations and Ion Ratios

Comparison of molar ion ratios appears to be useful in studying effects of salinity intrusion and freshwater inflows on Delta export water quality. Ion ratios, along with electrical conductivity, salinity, and ion concentration measurements, may be used to help identify the sources and mixing of water types.

Sodium to chloride molar ion ratios, in general, decrease as fresh water (Sacramento River at

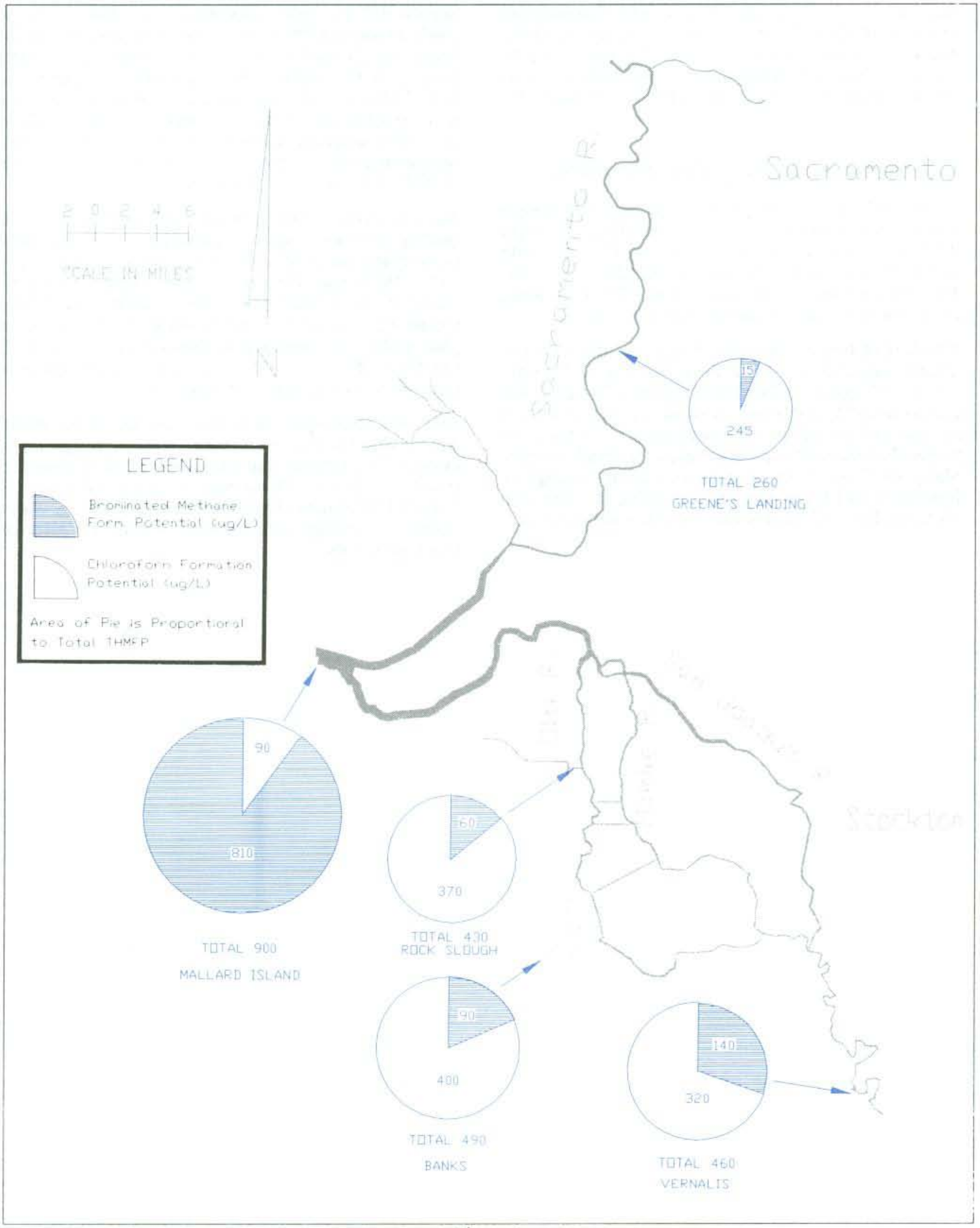


Figure 1
TRIHALOMETHANE FORMATION POTENTIAL IN THE DELTA, 5-YEAR MEDIAN, 1983-1987

Greene's Landing) mixes with sea water (Sacramento River at Mallard Island), which contains an abundance of sodium and chloride ions. A summary of the ion ratio data and frequency distribution of molar sodium to chloride ion ratios is shown in Chapter 3.

Future Water Quality Considerations

Quality of Delta drinking water supplies could change as a result of natural disasters that could cause major flooding or new construction that could alter Delta flow patterns. New water quality standards may also alter the economic and technical feasibility of treating Delta water to meet drinking water standards.

Flooding of major Delta islands can result in uncontrolled seawater intrusion deep into the Delta interior, which may be difficult to flush out. Delta islands are protected by a system of levees, but many of them are old and unstable. Of most concern are the nonproject levees, which are not State or federally owned. Many of these nonproject levees have inadequate freeboard and levee section, subsiding foundations, structurally weak peat soils, and other deficiencies.

Senate Bill 34, which was signed into law in March 1988, provides $120 million over a 10-year period for levee rehabilitation and other flood protection projects in the Delta. About half of this money is to help Delta reclamation districts rehabilitate their nonproject levees. The other half is for special flood protection projects on the eight western Delta islands most crucial to water quality and for the communities of Walnut Grove and Thornton.

New construction in the Delta could also impact water quality and will require evaluation. One proposal undergoing extensive environmental study is the Delta Wetlands Project, which would flood four islands to store 382,500 acre-feet of Delta water. The stored water would be sold to water users. Another plan under consideration includes expansion of Clifton Court Forebay and adding new intake gates to improve water quality and quantity.

The 1986 amendments to the Safe Drinking Water Act require the Environmental Protection Agency to develop regulations that include control of disinfection by-products. These regulations could lead to a lower THM standard and force many drinking water utilities to change disinfectants or consider alternative treatments.

The following recommendations, based on findings of this study, constitute possible changes in scope of the Interagency Delta Health Aspects Monitoring Program.

Increase the Number of Monitoring Stations

Additional stations should be established to improve the specificity of information collected and to facilitate comparison of data with other studies. The data should also be used to verify water quality models. Additional stations should be located at or near metering stations of the Department of Water Resources, U.S. Bureau of Reclamation, and U.S. Geological Survey and stations that are nodes of the DWR Fischer model.

Study the Possible Contribution of THM Precursor Loads from Primary Productivity in the Delta

Algal productivity is a potential source of organic THM precursor material, but the extent to which this affects THM formation potential is not known. At present, chlorophyll *a* and pheophyton are measured at the DWR Decision 1485 Delta stations and Suisun Bay stations. THM formation potential should be also be measured at these locations to determine if there is a correlation between these biological parameters and THM formation potential. Costs for additional sampling are minimal, as these are established semi-monthly runs. In addition, samples of chlorophyll *a* and pheophyton should be collected at the Interagency Delta Health Aspects Monitoring Program stations.

Begin Baseline Monitoring for Proposed Projects That May Affect Export Water Quality

By storing Delta water on several peat islands, the proposed Delta WetlandsProject could significantly impact Delta water quality by affecting THM formation potential. Data collection should be undertaken to determine baseline water quality information if the project is approved.

If Clifton Court Forebay gates are modified or southern Delta flows are altered, export water quality could change as a result. This area should be monitored before and after the proposed modification.

Investigate Sources of San Joaquin River Water Quality Problems

The impact of San Joaquin River water on the Delta remains in dispute. There is a need to better understand how the lower San Joaquin River water quality is affected by circulating export water. Dye studies supplemented with water quality analyses are recommended.

Determine Water Quality Under Dry Year Conditions for Future Project Operations and Planning

Current dry year conditions provide the opportunity to study worst-case conditions. Increasing sampling frequency and the number of monitoring sites would provide better information about impacts of the current drought. This could benefit planning for future droughts.

Determine the Significance and Relationship of Total THM Formation Potential Concentrations in Clifton Court Forebay to Levels in Downstream State Water Project Facilities

Much attention has been focused on the quality of Delta water supplies. The extent to which algal production in downstream State Water Project facilities or other factors contribute to total THM formation potential in water delivered by the State Water Project is not known. A study should be designed to collect water samples within the aqueduct system and State Water Project reservoirs to assess and compare the relative significance of water quality changes within the State Water Project after the water is exported from the Delta.

Chapter 1
INTRODUCTION

In 1981, the Department of Water Resources conducted a study of THM formation potential prior to the effective date of the THM regulations. Water from the Sacramento River upstream of the Delta was found to be lower in THM-forming agents than was water of the southern Delta. In addition, the THM study raised a number of broader questions concerning use of the Delta as a drinking water source.

In 1982, the Department commissioned a panel of independent scientists to evaluate human health aspects of Delta water supplies. In its December 1982 report, the panel identified sodium, asbestos, and THM-forming materials as water quality parameters of health concern.

The panel concluded that previous Delta monitoring had been directed toward ecological, rather than human health, concerns. For that reason, data were lacking upon which to base other conclusions related to drinking water and human health. A program of data collection and analysis was recommended to resolve the lack of information and to address human health concerns associated with using the Delta as a source of drinking water.

In response to the recommendation, the Department of Water Resources began the Interagency Delta Health Aspects Monitoring Program in July 1983. The Program monitors the quality of Delta water supplies with respect to human health concerns. The program is supported and guided by a number of water agencies, including East Bay Municipal Water District; Contra Costa Water District; and the urban water contractors of the State Water Project, including Metropolitan Water District of Southern California, Santa Clara Valley Water District, Alameda County Water District, and Alameda County Flood Control & Water Conservation District, Zone 7.

The Department of Health Services supports the program through participation in the Technical Advisory Group, which includes representatives of the other participating agencies and provides guidance and recommendations for the program. June 1988 marked the end of the fifth year of the program.

Study Area

Figure 2 shows the Sacramento-San Joaquin Delta as geographically defined in California Water Code Section 12220. About 60 islands and tracts lie in parts of six counties -- Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo. The Delta extends over 738,000 acres, about 550,000 acres of which are prime agricultural land. The fringes of the Delta have industrial areas, and towns and other urban developments occupy parts of 12 islands or tracts. Table 1 provides a statistical summary of Delta demography, geography, economy, and wildlife.

Field Work

Interagency Delta Health Aspects Monitoring Program stations represent a variety of water types: fresh water, brackish water, bay water, and agricultural drainage. Stations have changed with changing priorities of the program. Pumping plant and intake stations are sites where Delta water is taken into State Water Project facilities and exported for municipal and industrial use.

Primary monitoring stations are shown in Figure 3. Some stations are part of a network where tides, flow, and electrical conductivity are monitored continuously for water project operations by the Department of Water Resources and the U.S. Bureau of Reclamation.

Constituents for this study, selected because of their potential health impacts, include total THM formation potential, pesticides and other synthetic organic pollutants, trace metals such as selenium, minerals, and asbestos. Existing and proposed State and federal drinking water standards and advisories for these constituents are presented in Appendix F.

Monthly sampling was conducted for total THM formation potential, chloride, calcium, boron, sodium, magnesium, potassium, sulfates, nitrates, selenium, turbidity, color, electrical conductivity, pH, hardness, alkalinity, total dissolved solids, temperature, and dissolved oxygen. Pesticide sampling periods were selected to coincide with summer pesticide application, winter surface water runoff, and spring preemergent herbicide application.

Field measurements of basic water quality parameters were made on-site at each station in a mobile laboratory van. Samples for laboratory analyses were treated with fixatives or filtered and stored according to appropriate methods. Samples were delivered to the laboratories within 24 hours after collection, and chain of custody was documented. Details of field and laboratory methods can be found in Appendix E and in Interagency Delta Health Aspects Monitoring Program progress reports.

Laboratory Work

DWR contracted with outside laboratories for organic chemical analyses, such as pesticides and priority pollutants, and for the asbestos analyses. Total THM formation potential analyses have been performed by contract laboratories and, in the early program, by the DWR Bryte Laboratory. Contract laboratories used were: Clayton Environmental Consultants (Pleasanton), Enseco, Inc. (West Sacramento), and EMS Laboratories (Hawthorne).

The laboratories employed rigorous quality control procedures to assure validity of results. Sample collection, handling (including chain-of-custody), and storage were carefully controlled to reduce the likelihood of errors in sample identification and integrity. Field replicates, laboratory sample spikes, and duplicates were used to help assure accurate results.

Results of quality assurance and quality control analyses were required from the laboratories, and the information was reviewed by the Department of Health Services, the Department of Water Resources, and the Technical Advisory Group. Suspect data attributed to laboratory errors were investigated and appropriate steps taken, such as deletion, correction, or reanalysis. Quality control data are provided in Appendix E.

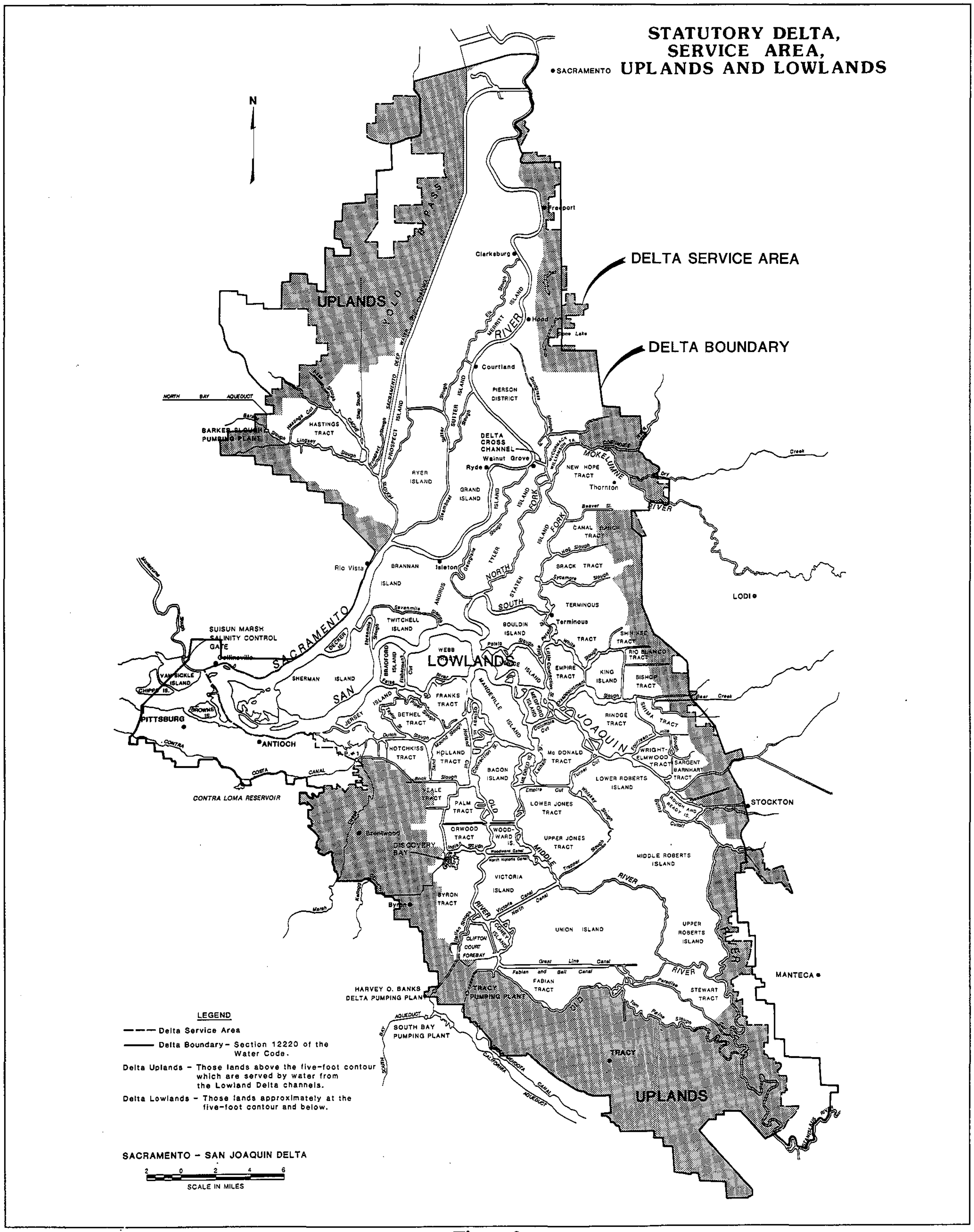


Figure 2
STATUTORY DELTA

Table 1
DELTA STATISTICS

DEMOGRAPHY

Population: 200,000
Counties: Alameda, Contra Costa, Sacramento, San Joaquin, Solano, Yolo
Incorporated Cities Entirely Within the Delta: Antioch, Brentwood, Isleton, Pittsburg, Tracy
Major Cities Partly Within the Delta: Sacramento, Stockton, West Sacramento
Unincorporated Towns and Villages: 14

GEOGRAPHY

Area

(acres)		
	Agriculture	520,000
	Cities and Towns	35,000
	Water Surface	50,000
	Undeveloped	133,000
	Total Acres	738,000

Levees

(miles)		
	Project	165
	Direct Agreement	110
	Nonproject	825
	Total Miles	1,100

Rivers Flowing Into the Delta: Sacramento, San Joaquin, Mokelumne, Cosumnes, Calaveras
(These plus their tributaries carry 47% of the State's total runoff.)

Diversions Via Aqueducts Through or Around the Delta
- San Francisco Public Utilities Commission
- East Bay Municipal Utility District

Diversions Directly From the Delta
- Western Delta Industry
- City of Vallejo
- 1,800+ Agricultural Users
- Contra Costa Canal
- State Water Project
- Central Valley Project

ECONOMY

Valuation

(1980)		
	Land	$1,600,000,000
	Pipelines	100,300,000
	Marinas	100,000,000
	Roads	68,000,000
	Gas Wells	26,900,000
	Railroads	11,000,000
	Utilities	1,300,000
	Total	$1,907,500,000

Recreation

User-Days Annually	12 million
Registered Pleasure Boats	82,000
Commercial Recreation Facilities	116
Public Recreation Facilities	22
Private Recreation Associations	22
Berths	8,534
Docks	119
Launch Facilities	27

Agriculture

Average Annual Gross Value $375 million

Main Crops:

Corn	Grain and Hay
Sugarbeets	Alfalfa
Pasture	Tomatoes
Asparagus	Fruit
	Safflower

Transportation

Interstate Highways	5, 80, 205
State Highways	4, 12, 84, 113, 160, 220
Railroads	Southern Pacific
	Western Pacific
	Atchison, Topeka & Santa Fe
	Union Pacific

Deep-water ship channels to Sacramento and Stockton transport 6 million tons annually

FISH AND WILDLIFE

Birds	200 species
Reptiles	15 species
Mammals	45 species
Amphibians	8 species
Fish	45 species
Flowering Plants	150 species

Major Anadromous Fish
- Salmon
- Striped Bass
- Steelhead Trout
- American Shad
- Sturgeon

Station Location Number	Station Name	Station Number
1	American River at Water Treatment Plant	A0714010
2	Sacramento River at Greene's Landing	B9D82071327
3	Cache Slough at Vallejo Pumping Plant	B9D81781448
4	Lindsey Slough at Hastings Cut	B9D81581462
5	Agricultural Drain on Grand Island	B9V81321357
6	Agricultural Drain on Tyler Island	B9V80791347
7	Little Connection Slough at Empire Tract	B9D80361300
8	Agricultural Drain on Empire Tract	B9V80361299
9	Rock Slough at Old River	B9D75841348
10	Clifton Court Intake	KA000000
11	Delta-Mendota Intake at Lindeman Road	B9C74901336
12	H.O.Banks Delta Pumping Plant at Headworks	KA000331
13	Middle River at Borden Highway	B9D75351293
14	San Joaquin River near Vernalis	B0702000
15	Lake Del Valle Stream Release	DV004000
16	Mallard Slough at Contra Costa Water District Pumping Plant	B8X80221556
17	Sacramento River at Mallard Island	E0B80261551
18	North Bay Interim Pumping Plant Intake	KG000000
19	Barker Slough at Pumping Plant	B9D81651476
20	Natomas Main Drain (Agricultural)	A0V83681312

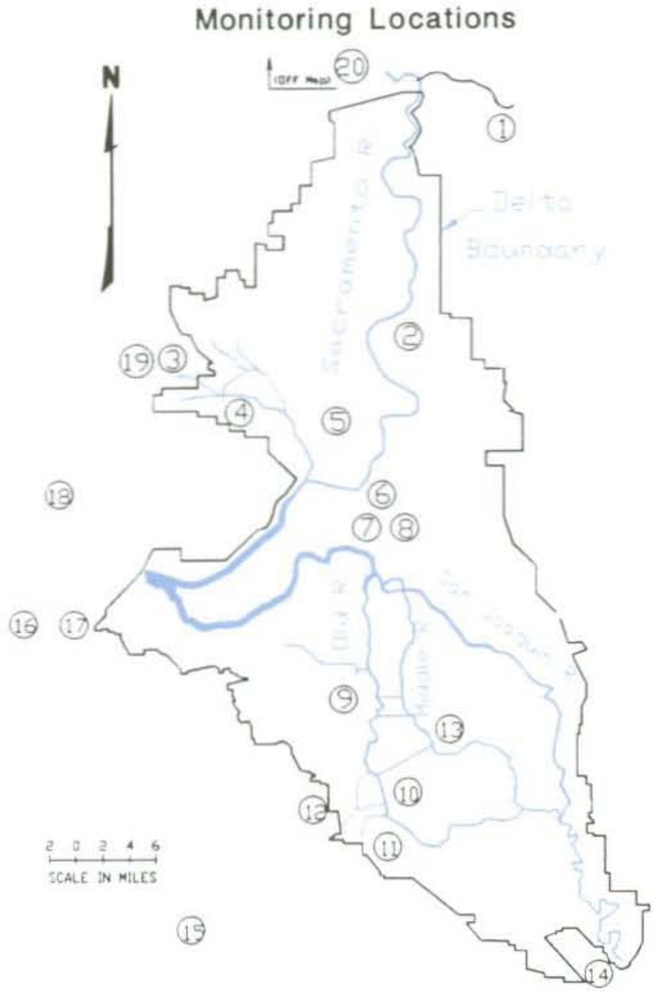


Figure 3
STATION LOCATIONS
Interagency Delta Health Aspects Monitoring Program

Chapter 2
MAJOR FACTORS AFFECTING WATER QUALITY

The amount of treatment required to make Delta waters meet drinking water standards depends on the quality of the water source and the regulatory requirements of the drinking water standard. Major factors affecting Delta water quality are:

» Regulatory controls in the Delta.

» Hydrodynamic conditions as influenced by inflow, floods, tides, and diversions.

» Domestic, industrial, and agricultural activities.

Drinking Water Standards

Regulatory actions such as changes to State and federal drinking water standards could result in the need to improve treatment of Delta water for drinking purposes.

The Environmental Protection Agency is now reviewing the 100 ug/L maximum THM standard for drinking water. Any new THM standard will likely be more stringent than the current standard.

In addition, 1986 amendments to the Safe Drinking Water Act require the Environmental Protection Agency to develop regulations that include control of disinfection by-products. These regulations could lead to standards that may force many drinking water utilities to change disinfectants or consider alternative treatment technologies.

If more restrictive THM standards are adopted, all alternatives for compliance should be explored. One way to reduce treatment needs is to reduce THM formation potential levels in raw water supplies from the Delta. One task of the Interagency Delta Health Aspects Monitoring Program is to examine ways to manage total THM formation potential in the Delta by understanding the sources and availability of THM precursors under all hydrologic conditions.

Regulatory Controls in the Delta

Decision 1485, known as the *Delta Plan*, was adopted by the State Water Resources Control Board in 1978 to protect Delta water quality and beneficial uses. Water quality standards were established to protect beneficial uses in the Delta and Suisun Marsh, including agriculture, fish and wildlife, and municipal and industrial uses. In addition, Decision 1485 requires that Delta flows into San Francisco Bay be sufficient to repel most seawater intrusion.

Decision 1485 covers salinity control, fish and wildlife protection, and terms and conditions in permits for the State Water Project and federal Central Valley Project. The underlying principle is that water quality in the Delta should be at least as good as it would have been had the CVP and SWP not been built, as limited by the constitutional mandate of reasonable use. The standards include adjustments in levels of protection to reflect changes in hydrologic conditions under different water year types.

The State Water Resources Control Board is currently conducting hearings (the Bay-Delta Hearings) to determine if revisions to Decision 1485 are necessary. The Department of Water Resources is participating. Any changes in Decision 1485 could affect operations of the Central Valley Project and State Water Project.

Hydrodynamic Conditions

Hydrodynamic conditions that work with other factors to influence water quality in the Delta include: inflow, runoff and outflow, floods, tides, and water exports and other diversions.

River Inflows

The principal streams of the Delta are the Sacramento and San Joaquin rivers and their tributaries, including the American, Calaveras, Cosumnes, Feather, and Mokelumne rivers (tributary to the Sacramento) and the Merced, Stanislaus, and Tuolumne rivers (tributary to the San Joaquin). These river systems drain the eastern parts of the Coast Ranges, the western parts of the Sierra Nevada, and almost all of the Central Valley. They provide about 47 percent of California's total runoff.

Streamflow into the Delta varies seasonally and is also influenced by SWP releases from Lake Oroville and CVP releases from New Melones Reservoir and Lake Shasta. Some flow continues across the Delta and is exported via the California Aqueduct and the Delta-Mendota Canal. The remainder flows out to San Francisco Bay and the Pacific Ocean.

Delta flow patterns are complex, and attempts to monitor and model them have been the subject of numerous studies by DWR and others for nearly 30 years. The DAYFLOW model is a computer program developed in 1978 as an accounting tool for determining net Delta outflow at Chipps Island using historical Delta boundary hydrology, internal consumption, and exports. The model's accuracy on a daily timestep is limited, because it does not incorporate tidal fluctuations in tidally influenced areas. The DAYFLOW model is described in Appendix H.

A comparison of continuous daily flows (365 data points per year) and monthly average DAYFLOW data (12 data points per year) revealed that both were adequate in representing hydrologic conditions in the Delta. However, when mean daily flow data for Interagency Delta Health Aspects Monitoring Program sampling dates were used to represent the flow for that sampled month, results did not resemble the hydrologic conditions seen in the DAYFLOW daily and monthly average plots. For example, the comparison in Figure 4 shows that daily flows varied widely within a given month as upstream releases were controlled to meet Delta salinity standards.

Five-day average flows better reflect hydrologic patterns observed in the DAYFLOW graphs. For each sampling date, the daily flow of that day was averaged with data for the previous four days. The assumption was that the water quality stabilized over a 5-day period and would better reflect the flow environment within which the sample was taken. DAYFLOW data for use in this analysis were available only through September 1987.

Runoff and Outflow

Water years begin October 1 and end September 30 of the following year, to correspond with the natural wet and dry cycle. Water years encompassing the Interagency Delta Health Aspects Monitoring Program (1983-1986) are described below with respect to meeting the Decision 1485 water quality standards for the Delta. Data for water year 1987 have not yet been interpreted.

Water Year 1983

California experienced record breaking precipitation in most river basins during the 1983 water year. Unimpaired runoff in the Central Valley was 36 million acre-feet above normal. The water year was classified "wet", as determined by the Decision 1485 Four-Basin Index. Delta outflows approached 400,000 cubic feet per second in March and remained above 20,000 cfs through September. These extraordinarily high flows created a natural hydraulic barrier against salinity intrusion, and the Delta remained essentially a fresh water environment.

Electrical conductivity at Chipps Island exceeded 200 microSiemens per centimeter (about 91 mg/L chloride) only once, during a short period in August. The hydrograph of these flows is shown in Figure 5.

The Department of Water Resources operated the State Water Project in full compliance with Decision 1485 Delta standards during 1983. Enough water was available to satisfy delivery requirements, and all Delta export water quality objectives were met. The unusually high outflows resulted in low salinities throughout 1983 at all major locations at which standards apply.

Water Year 1984

The 1984 water year began with heavy precipitation in November and December, threatening to repeat the previous record year. As the SWP operation center was adjusting for a heavy runoff, the weather pattern changed, and the above-normal first quarter was followed by well below normal precipitation for the remaining three quarters.

The State Water Resources Control Board still classified 1984 as a wet year, because runoff exceeded 34 million acre-feet. Below normal runoff in April through July, however, resulted in the year being further designated as one of subnormal snowmelt, allowing lower Delta outflow standards to be in effect during that period.

In 1984, net Delta outflow averaged above 30,000 cubic feet per second through the end of March, and Decision 1485 water quality standards were easily met. Delta outflow remained below 14,000 cfs from May through September.

Decision 1485 Delta salinity standards became the controlling factor in June, requiring outflow to be maintained at a level substantially exceeding the minimum outflow requirements for a subnormal snowmelt year. Outflow averaged about 10,600 cfs in May, just under 8,000 cfs in June, and about 9,800 cfs in July. Sacramento River streamflow standards at Rio Vista were met by wide margins in 1984. The May through July export limits of Decision 1485 were also met in June and July.

All Decision 1485 Delta salinity standards were easily met in 1984, except at Jersey Point. For a short period in late July, the Decision 1485 mean EC standard of 450 microSiemens per centimeter was approached at the Jersey Point station, but the standard was not exceeded.

Water Year 1985

Water year 1985 was characterized by fluctuations in precipitation, beginning with above normal precipitation over much of the State. November precipitation set records, with some stations reporting more than 500 percent of average. This pattern changed abruptly, however, with record low precipitation in January. Many stations had less than 10 percent of average January precipitation, and several had no precipitation at all during the month.

February precipitation was slightly over half of normal statewide. In March, rainfall was near normal overall but was light in the northern and southern ends of the State. April precipitation was light and failed to improve the water supply situation. Runoff in Northern California was below normal.

Streamflows in the San Francisco Bay area were less than half of average, and Central Valley streamflows were half to three-quarters of average. Reservoir storage generally was less than the year before. The State Water Resources Control Board classified 1985 as a "dry" year for the Delta.

Early in 1985, Delta outflow averaged slightly over 12,000 cfs, then declined gradually through spring and summer. Average monthly outflow was 8,800 cfs in March, 6,900 cfs in April, but was increased to 7,200 cfs in May to help reduce salinity at Emmaton. Outflow continued to decline through summer, reaching a low of just under 1,900 cfs in August. Delta outflow generally increased during fall and reached 8,400 cfs in December.

Delta outflow remained above the minimum required by Decision 1485. Sacramento River flow at Rio Vista also remained above the Decision 1485 minimum.

Decision 1485 export limitations were met in 1985, although by slim margins in May and June. The maximum permissible State Water Project export for June was increased from 3,000 to 3,300 cfs to compensate the project for participating in an interagency controlled flow study earlier in the spring.

All Decision 1485 Delta salinity standards were met in 1985, except that from May 11 through 14 the 14-day mean electrical conductivity was 460 uS/cm. The standard is 450 uS/cm.

Water Year 1986

Water year 1986 was wet, but rainfall was erratic. Fall 1985 was dry, but higher rainfall followed in January 1986. A series of storms in mid-February produced record-breaking runoff and much flooding. Despite the heavy February rainfall, the April 1 snowpack in the northern Sierra was less than normal. Spring runoff in the Sacramento River basin was about 80 percent of normal. In the San Joaquin River basin, snowpack was above average, and runoff was about 140 percent of normal.

By year's end, reservoir storage and streamflow in the State were at or slightly above average. The Four-Basin Index final classification for 1986 was "wet". April-July unimpaired snowmelt runoff was 5.8 million acre-feet, which designated 1986 as a subnormal snowmelt year.

Delta outflow was as erratic as the weather. During January, outflow averaged about 10,000 cfs. In early February, it had increased to about 30,000 cfs with the late January rainfall. Outflow increased with the heavy rainfall in late February and early March, averaging over 250,000 cfs, with peaks up to 500,000 cfs on some days. Outflow declined gradually during spring, and by June it was about 9,000 cfs. During summer it averaged about 6,000 cfs. In fall and early winter 1986, outflow fluctuated with rainfall but generally remained below 12,000 cfs.

Delta outflow and Sacramento River streamflow at Rio Vista both remained above minimums required by Decision 1485.

All Delta salinity standards in Decision 1485 and the North Delta Water Agency contract were met during the year. "Balanced" water conditions were in effect in the Delta from June 21 to August 6. These conditions are mutually declared by the Department of Water Resources and the Bureau of Reclamation when upstream reservoir storage withdrawals plus other inflow are about equal to the water supply needed to meet Sacramento Valley uses, Delta water quality objectives, and exports.

The State Water Project was operated within export limits imposed by Decision 1485. Mean monthly SWP diversions were about 2,950 cfs during May and June and 3,850 cfs during July.

Floods

Flood protection from high tides and streamflow is provided by an extensive network of levees. However, due to the age of the levees and materials used to construct them, many islands are susceptible to flooding.

Levee protection is a major concern in the Delta. Failure of a levee can result in uncontrolled seawater intrusion into the interior Delta. More than a dozen islands have been flooded during the last 8 years, and some islands have flooded more than once.

Delta levees are classified as *project* or *nonproject* levees. Project levees are part of the Federal Flood Control Project and are primarily associated with the Sacramento and San Joaquin Rivers. They are constructed according to modern engineering principles of stable materials such as mineral soils. Only about 35 percent of Delta levees are project levees. The other 65 percent are nonproject levees that generally meet less stringent standards for flood protection. They are constructed mostly of rich organic peat soils that have low density and are highly compressible. Many of these nonproject levees have inadequate freeboard and levee section, subsiding peat foundations, marginal stability, seepage problems, poor maintenance, and other deficiencies. The entire Mokelumne River system in the northern Delta relies on nonproject levees for protection.

In 1980, the Department inspected the nonproject levees at 52 tracts and islands. Based on U.S. Army Corps of Engineers standards for project levees, 20 tracts and islands were rated as fair, 28 poor, and 4 as very poor.

Through the assistance of the Delta Levee Subventions Program (being upgraded by Senate Bill 34), 41 percent of the islands and tracts now meet minimum standards specified by the State's *Flood Hazard Mitigation Plan*. Most of the districts plan to upgrade their levees to these minimum standards by 1991.

Tides

Over 700 miles of waterways meander through the maze of Delta islands. Most of the islands lie below the surrounding water level to as much as 25 feet below the mean tide level.

Tides in the Delta not only threaten the levees, but they bring with them periodic intrusion of seawater, which mixes into the fresh Delta water. Seawater intrusion causes problems such as scaling and corrosion of pipes and tanks, damage to crops, increased formation of brominated trihalomethanes during water treatment, and raised sodium levels in drinking water.

Tidal currents accompany the periodic rise and fall of sea level. In the Delta, tidal currents modify streamflow. Seawater can intrude into the Delta when outflows are low or when tides are high. Winds and storms can increase the magnitude of high tides and increase seawater intrusion.

Water Exports and Diversions

Water supplies are transferred through the Delta for export to several public agencies that have long-term contracts with the federal Central Valley Project and the State Water Project. These agencies include Bay Area water agencies as well as those in the central and southern part of the State. Other water districts also divert water. Together, these diversions meet all or part of the water needs of more than 16 million of California's 24 million residents and more than 4 million of the 10 million acres of irrigated farmlands.

Pumping to divert and export Delta water affects water quality. To protect water quality and water rights in the Delta, the Department of Water Resources and U.S. Bureau of Reclamation developed a plan to coordinate release and export operations. This Coordinated Operations Agreement, executed in November 1986, allocates the responsibility of the SWP and CVP and the share of flows necessary for maintaining Delta water quality.

Agricultural Activities

Agriculture is the primary use of land in the Delta. Average annual gross value is $375 million. More than 520,000 acres (70 percent) of Delta land is used for agriculture. Farming practices such as leaching to reduce soil salinity can significantly affect the quantity and quality of water in Delta channels. Irrigation facilities in the Delta are shown in Figure 6.

Salt Management

Special irrigation methods are used to protect crop production and to manage soil salinities in the Delta. For example, the Delta uplands, covering 51,000 acres, are composed of mineral soils and are surface irrigated using furrow-type, strip-check, or sprinkler irrigation methods. Irrigation water in excess of crop demand is applied to leach salts to below the reach of roots. Percolation of winter rainfall also leaches excess salts from the soil. If a shallow water table is present, salt control by leaching becomes much more difficult, and subsurface tile drains may be needed to collect and transport the drainage for disposal.

The Delta lowlands, covering about 469,000 acres, are mostly composed of organic soils and are subirrigated because of the shallow water tables (within 3 to 5 feet of the surface). With this method, salts are flushed from soils by use of temporary ditches to distribute water through the fields. Control structures are used to raise the water level in the ditches to percolate the water and salts through the soil and into the water table. Depth of the water table is regulated through the use of drains and large pumps.

While these farming practices are important means of protecting crop yields, Delta water quality is affected by the saline water pumped from agricultural drains. Concentration of salts in Delta channels can be elevated by agricultural discharges under low flow conditions when dilution and dispersion are reduced, as in the summer.

The contribution of agricultural salts to Delta water is a function of the amount of drainage water added compared to the volume of Delta receiving water. Drainage volume is low in October and rises rapidly to a maximum in December and January as a result of the winter pond leaching. A second low occurs in February after leaching has been completed. Drainage increases thereafter as lands are irrigated for seed germination in the spring. The final high drainage period occurs during the hot summer when irrigation demands are high.

Total drainage volume into the Delta is not known. However, an early study *(DWR, 1956)* on drainage in the Delta lowlands estimated about 30,000 acre-feet in October 1955 and a maximum of about 96,000 acre-feet in January 1955. In 1987, the Department of Water Resources located about 260 drainage pump stations in the Delta, compared to 206 reported in the 1955 study.

In addition to salt loadings, agricultural drain discharges also contribute organic compounds to Delta water. This is because much of the Delta is composed of peat, a highly organic soil containing large amounts of humic and fulvic acids, which are leached into water.

There is not yet enough information to quantify the relative contribution of THM precursors from agricultural activities as compared to sources such as in-channel peat soils, levee materials, and biological growth of algae and riparian vegetation. The Agricultural Drainage Investigation being conducted by DWR has the objective of determining the water quality effect of Delta agricultural discharges.

Pesticide Applications

Pesticide use is a major water quality concern in all parts of California. Pesticides and pesticide breakdown products have been found to be toxic to fish and wildlife and can cause cancer or have other health effects in humans. As a consequence, use and application of many pesticides are regulated and controlled by the Federal Government, State Department of Food and Agriculture, State Water Resources Control Board, Regional Water Quality Control Boards, and State Department of Health Services.

Pesticides are used on crops, irrigation ditches, channels, and levees. Agricultural waste water contains salts, THM precursors, and some detectable levels of pesticides, which can travel into the Delta waters. Varying concentrations of agricultural chemicals may also be found in sediments and the aquatic life of the Delta. Sources and concentrations of agricultural chemicals are being examined in the Agricultural Drainage Investigation.

Domestic and Industrial Activities

Discharges from waste water treatment facilities or from industrial sites often contain trace amounts of elements and organic chemicals. Surface runoff from urban areas and some rural areas can contain solvents, trace elements, pesticides, and other organic chemicals that are undesirable in drinking water.

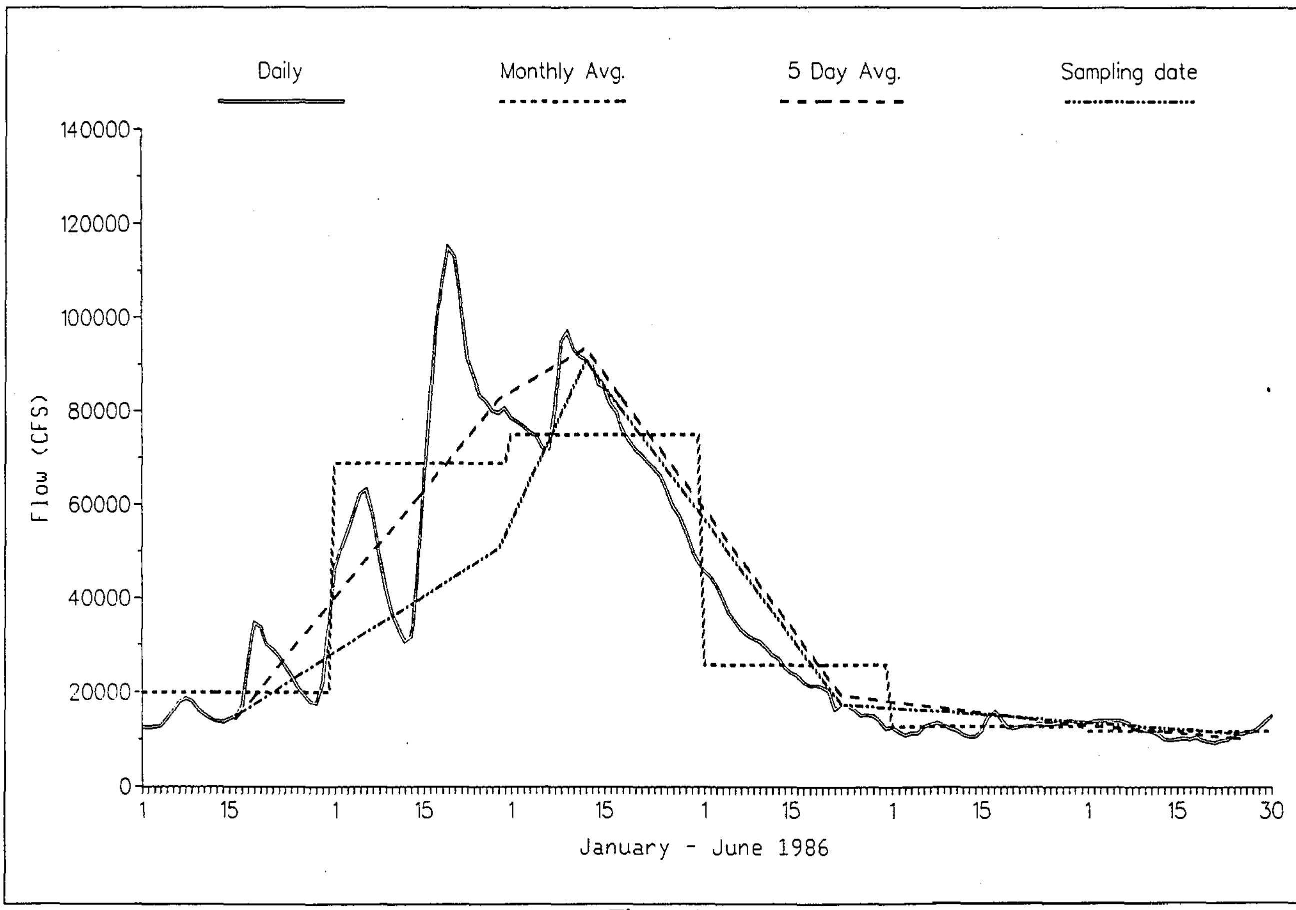


Figure 4
COMPARISON OF SACRAMENTO RIVER FLOW ESTIMATES
Greene's Landing Station, January-June 1986

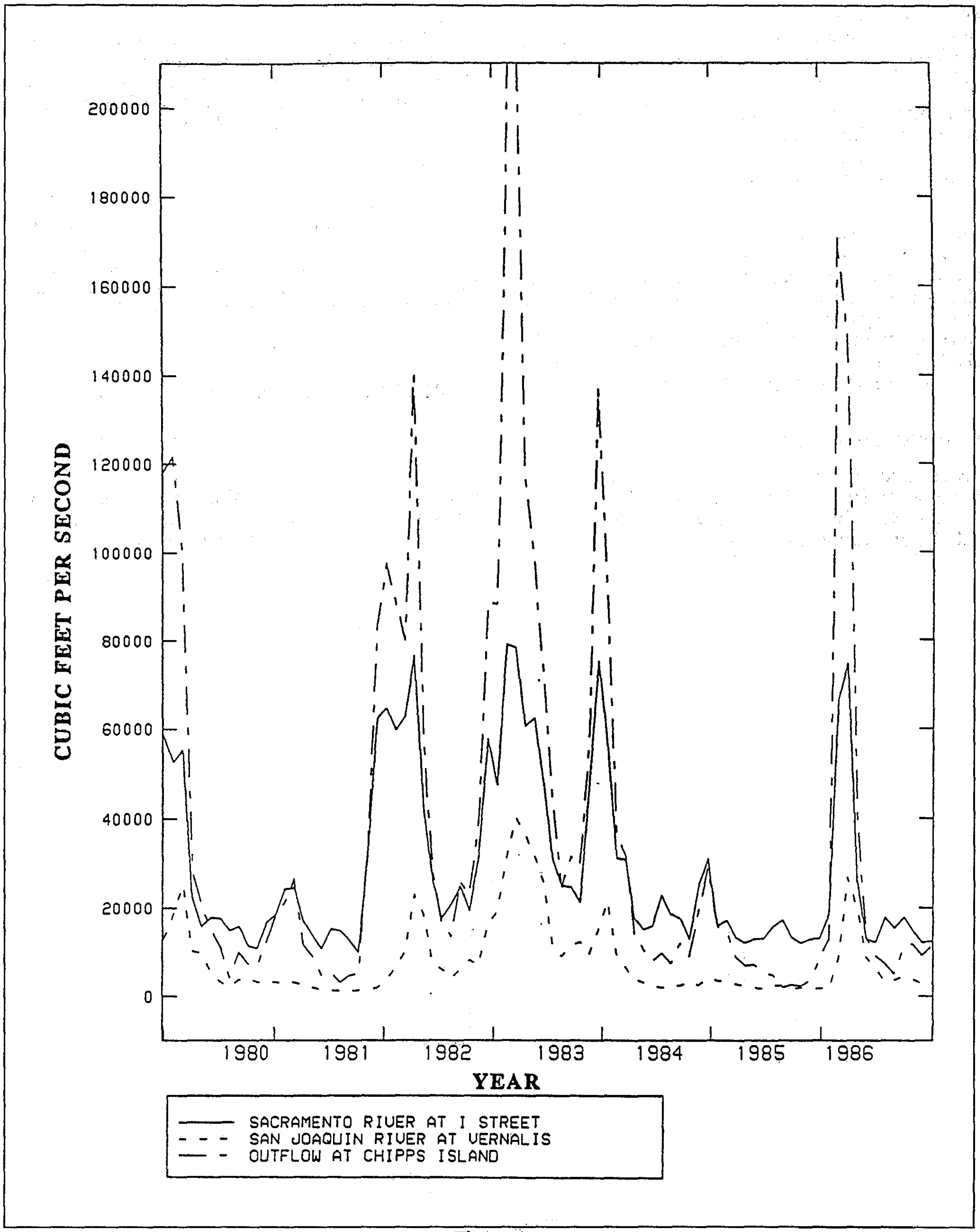


Figure 5
MONTHLY AVERAGE FLOWS

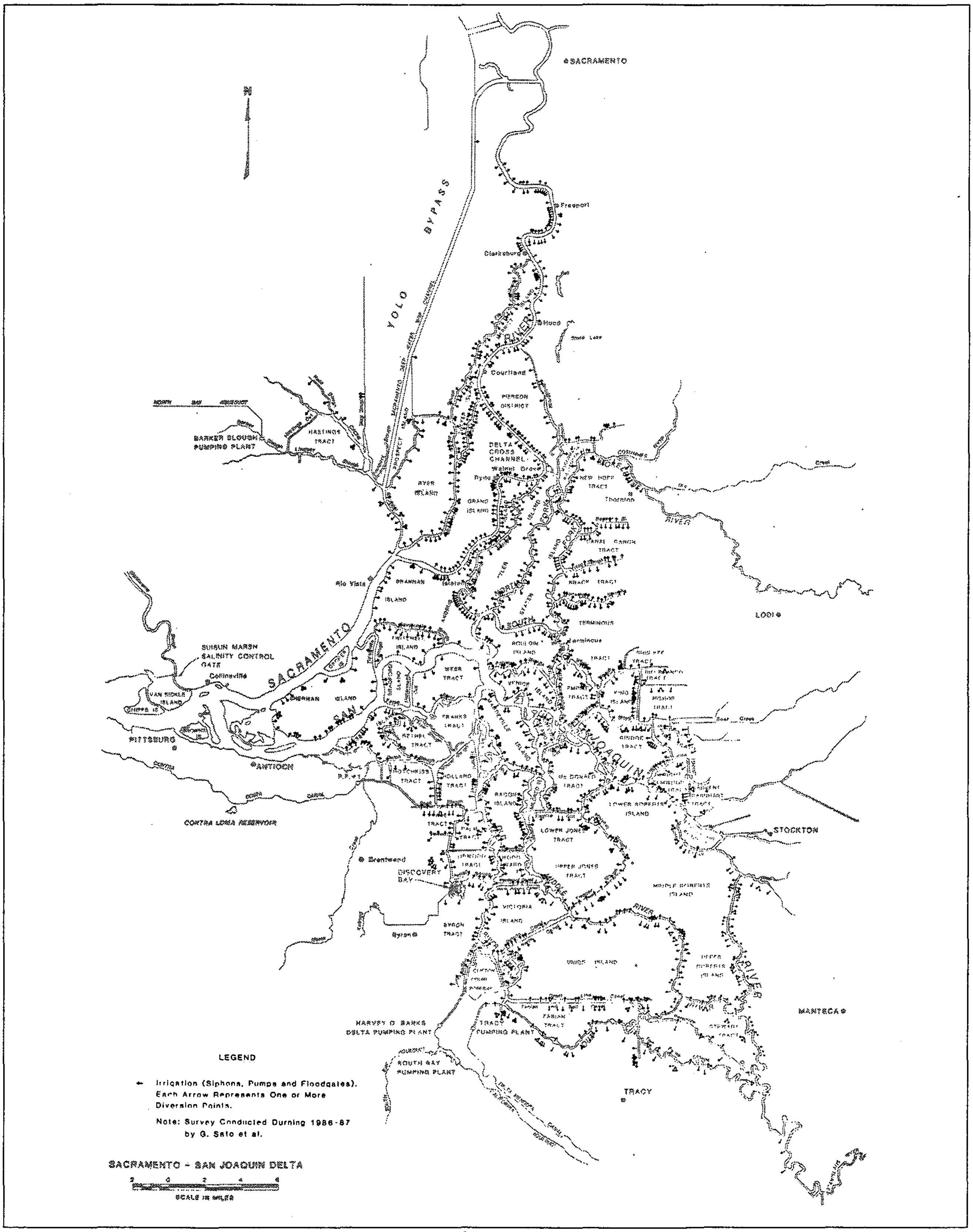


Figure 6
IRRIGATION DIVERSION POINTS

Chapter 3
5-YEAR DATA ANALYSIS

This chapter summarizes information collected by the Interagency Delta Health Aspects Monitoring Program during the five years beginning January 1983 and ending December 1987. Analyses are presented for data on total THM formation potential, selenium, sodium, pesticides, asbestos, and salinity-related factors. These discussions include the variability of observations, violations or near exceedances of drinking water standards or advisories, and trends or relationships with flow or other data.

A complete record of the data, by station and sampling date, is found in Appendix G.

Total Trihalomethane Formation Potential

It is standard practice to disinfect public drinking water supplies prior to distribution. However, disinfection by chlorination can form harmful concentrations of chemical by-products. THMs are one group of disinfection by-products formed as chlorine reacts with organic matter in the water. THM compounds include: chloroform (CHCl3), dichlorobromomethane (CHCl2Br), dibromochloromethane (CHBr2Cl), and bromoform (CHBr3).

Water treatment facilities must reduce the total concentration of THMs to 100 ug/L to meet current State and federal drinking water standards. However, the Environmental Protection Agency is now considering a THM drinking water standard that may be lower than 100 ug/L. Water purveyors are, therefore, concerned about the technical feasibility, reliability, and cost of meeting a more stringent standard when using Delta water.

The drinking water standard for THMs of 100 ug/L for treated water cannot be directly compared to concentrations of THM formation potential found in Delta water, because drinking water standards apply only to *treated* drinking water or water supplied to the consumer rather than to drinking water *sources.*

Total THM formation potential is a measurement to assess relative concentrations of THMs in raw water supplies, and, accordingly, does not predict actual concentrations of THMs in finished drinking water. Total THM formation potential of raw water can be estimated by means of a laboratory analysis known as a THM formation potential assay. In this test, water samples are chlorinated in excess of the chlorine demand of the water. The samples are incubated at 25 degrees Celsius for 7 days, then the chlorine is deactivated, or quenched, and analyzed for THMs.

Many factors, including temperature, pH, and chlorine contact time, affect actual THM formation in water treatment facilities. A definitive mathematical relationship between total THM formation potential of Delta water supplies and THM concentrations following treatment has not yet been established. However, high total THM formation potential is a useful indicator of problems that may be encountered during water treatment.

Total THM formation potential is generally lower at the fresh water stations (American River, Greene's Landing), with much higher values in the central Delta stations (Rock Slough, Clifton Court Intake, Banks Headworks, Delta-Mendota Canal Intake, Middle River) and agricultural drainages (Tyler, Grand, Empire). Table 2 shows frequency of total THM formation potential at various stations.

The range of concentrations at a given station can vary widely over the course of a year. The Sacramento River at Mallard Island station had the highest median values of total THM formation potential. High availability of organic matter and bromide ion account for the high formation potential at this site and at Rock Slough, Banks, and Vernalis. Figure 7 shows the highest, median, and lowest total THM formation potential concentrations for each year at the five key stations. This figure also shows that the Greene's Landing station has the lowest total THM formation potential. At Mallard Island, total THM formation potential averages were about 2.5 times those at Greene's Landing. Total THM formation potentials at Vernalis and Banks were about equal.

In summary, Delta waterways are enriched in THM precursor materials, especially the interior channels and those areas influenced by seawater. Untreated Delta water supplies have THM formation potential values 3 to 9 times higher than the THM standard for treated water. At some locations, much of that is attributed to bromide ions in the water.

Brominated THM Formation Potential

During chlorination, bromide ions in the water compete with chlorine in forming THM compounds. Because bromine (atomic weight 79.909) is heavier than chlorine (atomic weight 35.453), brominated THM compounds substantially increase in weight proportional to the number of bromine atoms present (molecular weights of $CHCl_3$ [119.36], $CHCl_2Br$ [163.82], $CHBr_2Cl$ [208.28], and $CHBr_3$ [252.74]). Therefore, the heavier bromomethanes can result in higher concentrations of THMs than with chloroform ($CHCl_3$) alone. THM compounds containing bromine atoms can complicate THM treatment and control processes.

The significance of brominated THM compounds relative to total THM formation potential was examined. Brominated formation potential is defined as the sum of trihalomethanes containing bromine (bromoform, dichlorobromomethane, and dibromochloromethane). A 5-year summary of the high, low, and median percentage by weight of observed total bromomethane formation potential is shown in Figure 8.

Ocean water is high in bromide ions, as well as many other ions (e.g., sodium). The data indicate which stations occasionally were affected by bay water salts (or other sources of bromides) mixing with fresh water. Locations demonstrating significant presence of bromides in the water are Sacramento River at Mallard Island, Rock Slough at Old River, Clifton Court Intake, Delta-Mendota Canal Intake, and San Joaquin River near Vernalis.

Bromomethane THM formation potentials dramatically change under conditions of high or low outflow from the Delta. During March 1986, outflows caused by February floods were so high as to change the quality of the Mallard Island station to a fresh water station rather than a brackish water station. Low flow conditions similar to those during the 1976-1977 drought occurred in December 1985. Salinity rose to unusually high levels, indicating significant sea water intrusion.

Figure 9 shows total THM and bromomethane THM formation potentials measured at five stations during high outflow (March 1986). The Mallard Island station brominated fraction dropped from an average of 87 percent to only 6 percent in March 1986. Brominated fractions at the export stations dropped from averages of 21 percent and 23 percent to about 10 percent, indicating that an increased proportion of fresh water was reaching these stations.

In contrast, Figure 10 shows total THM and brominated THM formation potentials measured at five stations during low outflow (December 1985). The brominated fraction measured at Mallard Island had risen from an average of 87 percent to 99 percent. At Banks and Rock Slough, the brominated fractions were nearly three times the average concentrations, showing the influence of sea water intrusion.

The Sacramento River upstream of Greene's Landing is the major water supply for many cities, including Sacramento. This part of the river does not pose a major treatment problem to achieve the current 100 ug/L THM standard for treated water.

Bromomethane formation is a potential concern to the Contra Costa Water District and Contra Costa Canal water users, because Rock Slough is the main pumping station for water exportation via the Contra Costa Canal.

Selenium

Selenium from Central Valley agricultural drainage discharged into the San Joaquin River is found in very low levels in the Delta.

Selenium is a naturally occurring element that, in high concentrations, can cause deformities in animals and birds. In humans, high levels can cause gastrointestinal problems and loss of hair and nails. Low concentrations of selenium are essential, however, and selenium deficiencies can cause infertility and a number of other conditions.

In 1984, the U.S. Fish and Wildlife Service discovered deformed young birds at Kesterson Wildlife Refuge, near Los Banos, California. These were attributed to high selenium levels discovered there and in the San Luis Drain, which emptied into Kesterson. The source of the selenium was agricultural drain water from high-selenium soils in the western part of the San Joaquin Valley. The San Luis Drain has since been closed.

In response to public concern stemming from the problems found at Kesterson, selenium monitoring was started in the San Joaquin River and the Delta. During the 5-year study, selenium values never exceeded the drinking water standard of 10 ug/L at any of the Interagency Delta Health Aspects Monitoring Program stations. Table 3 summarizes results of the selenium sampling. These data indicate that, from a human health standpoint, selenium concentrations are not a threat to Delta drinking water quality.

Sodium

High levels of sodium can harm crops, corrode pipes, and make water unfit for human consumption. In addition, excess sodium in the diet can cause health problems for people with high blood pressure.

There are two major sources of sodium in the Delta: sea water intrusion and waste discharges from industry, cities, and farms. Agricultural drain discharges concentrate salts due to evaporation and plant uptake of agricultural water.

Levels for sodium in drinking water have been established by the National Academy of Science. These levels -- 20 mg/L for people on severely restricted sodium diets and 100 mg/L for those on moderately restricted diets -- are not legally enforceable. There are no State or federal drinking water standards for sodium, but the Environmental Protection Agency recommends a sodium limit in drinking water of 20 mg/L for people on the most restrictive sodium diet (less than 500 mg/day total sodium intake from all sources).

It is unlikely that a federal drinking water standard for sodium will be promulgated in the near future. EPA recently removed sodium from the Drinking Water Priority List because:

» Evidence linking sodium intake from water to elevated blood pressure is inconclusive, and

» Most people's sodium intake comes from sources in the diet other than water *(Federal Register, Vol. 53, No. 24, January 22, 1988).*

A current EPA regulation requires all public water suppliers to monitor sodium in their drinking water and to report the levels to local health authorities *(40 CFR 141.41).* When there is a high sodium episode, water suppliers must notify the California Department of Health Services, which has been given primacy to regulate certain provisions of the federal Safe Drinking Water Act. DHS, in turn, coordinates with local health authorities to inform the public.

Table 4 shows the range of sodium concentrations at 15 locations. At Banks Pumping Plant, the 100 mg/L recommended limit was exceeded twice out of the 55 times water was sampled. Both samples were collected in the fall of 1987, when Delta outflow was low because of an extended dry period. Sodium levels were usually in the 20 to 99 mg/L range, which is tolerable for most people.

Sodium concentrations were consistently less than 20 mg/L at the American River Water Treatment Plant, Sacramento River at Greene's Landing, and North Bay Interim Pumping Plant stations.

Out of 214 observations, sodium concentrations at Rock Slough, Clifton Court Forebay, Banks, and the Delta-Mendota Canal Intake exceeded the 100 mg/L NAS criteria only 12 times over the 5-year period (range 10-154 mg/L), generally during extremely low Delta outflows.

Sodium concentrations exceeded the 100 mg/L criteria 90 percent of the time at Mallard Island. However, this western limit of the Sacramento River is subject to significant seawater intrusion and is not used as a drinking water source during low flow periods. Delta water is almost never consumed directly; it goes through a reservoir system where low-flow water (high in sodium) is blended with water that was pumped during periods of higher inflow.

Overall, sodium concentrations in the Delta do not pose a threat to consumers of drinking water taken from the Delta. However, during low outflow conditions, sodium may rise to levels of concern to individuals with moderate sodium restrictions. Those people on severely restricted sodium diets (less than 500 mg/day total sodium intake from all sources) generally consume sodium-free bottled water.

Pesticides

The monitoring program was designed to detect those chemicals that had a higher likelihood of being found at a monitoring site at a specific time of the year.

A selection process was developed to focus on pesticides most likely to pose problems at water treatment plants. The selection process involved examining the chemical and physical characteristics of various pesticides, as well as when and where they were likely to be found. In general, the selected chemicals were moderately to highly water soluble (more water soluble chemicals tend to remain in the water column and are harder to remove in the conventional water treatment process than are less water soluble compounds). The Department of Food and Agriculture pesticide use database was examined to determine use patterns and application locations of pesticides within the counties. Details of the pesticide selection process are in Appendix D.

Pesticide sampling focused on the summer pesticide application period, with additional sampling to include the first major winter runoff and the spring pre-emergent herbicide applications. The selection scheme was a systematic approach that eliminated costly broad scans by the laboratory, resulting in effective use of program funds.

The few pesticide contaminants found in Delta water samples were at concentrations marginally above laboratory detection, but considerably below health-based drinking water standards. Table 5 summarizes results of the 5-year pesticides monitoring and includes the list of pesticide drinking water standards for comparison.

Because the monitoring plan for pesticides was designed to produce worst-case results, the general absence of targeted pesticides indicates that pesticides do not generally constitute a significant threat to drinking water produced from the Delta.

Asbestos

Asbestos is a naturally occurring mineral that appears as minute fibers under a phase contrast electron microscope. Although there is no clear association of health problems with asbestos in drinking water, asbestos is a known human carcinogen when it is inhaled.

Based on equivocal research results, the Environmental Protection Agency has proposed a drinking water standard for asbestos of 7.1 million fibers per liter of water for fibers 10 microns or greater in length. This proposed standard is controversial, because present evidence of carcinogenicity from asbestos in drinking water is weak. In addition, there are difficulties in determining a standard test method and adequate quality assurance and performance procedures for analyzing asbestos fibers 10 microns or greater in water.

The proposed regulations under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) state that ingesting asbestos poses no significant risk of cancer *(22 CCR, Division 2 Chapter 3, Article 7, Section 12707)*.

The range of total (small and long fibers combined) asbestos fiber concentrations found during this study is shown in Table 6. In general, concentrations varied from 12 million to 7,500 million fibers per liter of water. One sample at Sacramento River at Mallard Slough reached a high of 26,000 million fibers per liter. This value may be incorrect because of a possible laboratory dilution error. EMS Laboratories, Inc., was unable to verify the error.

While these numbers seem high, asbestos concentrations in raw water bear little resemblance to those in the treated water supply. Normal treatment processes, including coagulation, sedimentation, and filtration, generally reduce initial asbestos concentrations by 99 percent or more. Treated water rarely contains asbestos concentrations exceeding the proposed federal standard of 7.1 million fibers per liter. Water agencies producing drinking water from the Delta are already able to meet the proposed new standard.

Although data were not available to determine the presence of asbestos fibers 10 microns or longer, it is estimated that about 1 percent of asbestos fibers in raw water supplies are greater than 10 microns.

Asbestos analyses were discontinued in 1986 because:

» Earlier studies sponsored by the Environmental Protection Agency showed no adverse effects associated with ingested asbestos;

» The precision of the asbestos analysis was low relative to asbestos concentrations (plus or minus an order of magnitude based on triplicate analyses);

» It was economically infeasible to collect definitive data on asbestos concentrations to account for the high variability in results; and

» Water agencies have met the proposed asbestos standard with little difficulty.

Salinity, Electrical Conductivity, and Ion Ratios

Salinity of water results from mineral and chemical input of the surrounding environment. Differences in salinity sometimes can be used to trace waters from different sources. Standard methods for characterizing waters include the measurement of salinity, electrical conductivity corrected to 15 degrees Celsius, and concentrations of natural and synthetic tracers such as elements, dyes, and contaminants.

In the lower Delta, EC measurements can reflect the influence of bay water, municipal and industrial wastes, and land-derived salts mixing with upstream fresh water. When multiple sources of highly saline water exist, sources cannot always be identified with EC measurements alone.

A 5-year summary of high, low, and median EC values at the Delta stations is shown in Figure 11. EC was higher at the bay water station (Mallard Island) and farm drainages than at the fresh water stations (Greene's Landing, American River).

In addition to EC and salinity measurements, comparison of molar ion ratios appears to be useful in studying effects of bay water intrusion. Molar ion ratios, along with EC, salinity, and ion concentration measurements, may be used to identify the sources and mixes of water types.

The relative abundance of major ions is nearly invariant regardless of salinity differences in open ocean waters. Sodium and chloride are the major ions in seawater, with concentrations of about 10,500 mg/L (sodium) and 19,600 mg/L (chloride). The molar ratio of sodium to chloride is about 0.85. Molar sodium ratios with other constituents, such as calcium and magnesium, may be useful in determining origins of various water supply sources; however, not enough data have been collected for a meaningful interpretation.

Average annual sodium to chloride molar ion ratios at major Delta channel sites are shown in Figure 12. Annual shifts in ratios reflected hydrologic conditions; years with higher flows had higher sodium to chloride ratios, and years with lower flows had lower ratios.

Average sodium to chloride molar ratios at Mallard Island ranged from slightly above 0.8 to as much as 1.5, depending on seasonal hydrology. The higher ratios were observed when Delta outflows were exceptionally high during the record flows of February and March 1986. When Delta outflow was low, the molar ion ratio resembled seawater, because Mallard Island water quality is subject to extensive tidal effects. Therefore, the ratios may be a good indicator of the geographical extent of a *salinity wedge* and source of salts.

Sodium and chloride concentrations at Sacramento River at Greene's Landing are relatively more variable than in the open ocean. Molar sodium to chloride ion ratios averaged from 2.3 to 2.5 for the first, second, and fourth calendar quarters. The mean ratio was higher, at about 2.9, for July through September. However, because fresh water is significantly lower in sodium and chloride concentrations than seawater, small changes in measured concentrations affect the calculated ratios significantly, making them appear to be more variable. Nevertheless, the molar ion ratios, along with other water quality data, do help characterize water quality.

The mean sodium to chloride molar ratios at Rock Slough, Middle River, Banks Pumping Plant Headworks, and the Delta-Mendota Canal Intake show that Sacramento River water originating at Greene's Landing and flowing into the Delta, Central Valley Project, State Water Project, and surrounding stations has been strongly influenced by water from various sources. The sodium to chloride ratios of 1.3 at these stations more closely resemble the San Joaquin River ratio of 1.4 and other Delta water than they do the Sacramento River ratio of 2.5. Likely influences on the sodium to chloride ratios at export stations include, but are not limited to, episodes of seawater intrusion, contributions of agricultural activities in the Delta, and contributions of the San Joaquin River.

The sodium to chloride ion ratio in water taken from the San Joaquin River near Vernalis is, on average, lower (more *marinelike*) than the Sacramento River at Greene's Landing. There are several possible explanations for this, and all may contribute to some extent:

» Water used in the San Joaquin Valley is returned, in part, to the San Joaquin River, and the ratios may simply reflect the source water pumped from the Delta.

» Other sources, such as salts of marine origin, may contribute to surface runoff and agricultural drainage water.

» Salts associated with agricultural activities may change the ionic ratios. The slightly higher molar ratio at Vernalis is likely due to a mixture of upstream fresh water release (e.g., Stanislaus, Merced, Tuolumne) with agricultural drainage.

Molar ion ratios in Delta agricultural drainage are more difficult to understand than those of pure fresh or ocean water. Data to characterize water quality of Delta drainage are limited to a few tracts and islands. The chemical molar ion quality of drainage depends on the quality of the applied water, use of farm chemicals, soil amendments, soil type, location, time, and hydrologic conditions. Studying the mineral quality of drainage will help identify and assess the impact on water quality. Some data collection is underway by the DWR Agricultural Drainage Investigation, but more stations need to be established.

Relationships Between Flows and Delta Water Quality

For most stations, water quality monitoring began in July 1983 and has continued through 1987.

Water Year 1983

Water year 1983 was classified as wet; average outflow was near 400,000 cfs in March and remained above 20,000 cfs through September. The high flow created a strong natural hydraulic barrier against seawater intrusion. This is demonstrated by low EC values and high molar ratios. Sodium to chloride ratios were 1.3 to 1.5 from July through December at the Banks Headworks and Clifton Court Intake stations; EC values were generally less than 300 uS/cm at the two stations. Molar sodium to chloride ratios appeared steady at the other Delta stations, corresponding with steady flows during the last half of the year.

Water Year 1984

In 1984, outflow averaged above 30,000 cfs through March, then fell to below 14,000 cfs from May to September. Summer outflows were 10,600 cfs in May, 8,000 cfs in June, and 9,800 cfs in July. Molar sodium to chloride ratios at Banks and at the Clifton Court Intake were above 1.3, except for June, when the Banks ratio was about 1, corresponding to the low Delta outflow in June.

Water Year 1985

Water year 1985 was classified as dry. Molar sodium to chloride ratios at the Rock Slough at Old River station rose from about 1.4 to 1.8 in January through April, then steadily fell to about 1. Sacramento River inflows gradually declined from June to November. At Mallard Island, the ratio was steady at 0.9 to 0.8

from May to December. There were no data to calculate ratios prior to May 1985 at this station. The 5-day average Delta outflow at Chipps Island was near zero or negative, indicating an extremely low net outflow. At Vernalis, the ratio fell from 1.7 to 1.3, corresponding to the 5-day average San Joaquin River flows, which fell from about 4,000 cfs in January to 2,000 cfs in December. The lower ratio could be attributed to the return of CVP and SWP waters via agricultural drainage.

Electrical conductivity at Vernalis resembled that of export water during the last half of 1985, suggesting that the San Joaquin River might have been a major source of export water. However, the molar sodium to chloride ratio indicated that the quality of export water was similar to water flowing into the southern Delta through Old and Middle rivers. The source of this water is most likely the Sacramento River. This conclusion appears to be supported by San Joaquin River streamflow data, which were relatively low and unchanged from 1984.

The changes in molar ratios at Banks and Clifton Court intake reflected progressively lower outflows and higher salinities in 1985. Ratios were high (1.3-1.4) during the winter, then progressively decreased to less than 1 by October 1.

Water Year 1986

In February 1986, heavy rainfall resulted in extensive flooding in the Sacramento Valley. Ion ratios at Mallard Island rose from 0.8 to 1.5, reflecting the increased freshwater flows. Sodium concentrations fell from 2,180 mg/L to 12 mg/L, and EC dropped from 10,700 uS/cm to 169 uS/cm. The ion ratio returned to about 0.85 in May and stabilized through September.

The high March flows led to high molar ratios (1.3 and higher) at Banks and the Clifton Court Intake. Clifton Court intake water resembled Rock Slough water through August. Sodium, chloride, and EC values were lower and corresponded to the higher ratios during this period. The Vernalis station ratio peaked to 1.6 in March, corresponding to high San Joaquin River flows of about 24,000 cfs. The ratio then declined as San Joaquin River flows dropped.

Water Year 1987

Monthly molar ratios reflected the dryness of 1987; June through December ratios were less than 1.1 at Banks and the Clifton Court intake.

Correlations Between Total THM Formation Potential and Other Factors

Simple linear regressions were calculated to determine the strength of the relationship between THMs and flows in the Delta. The R-squared values are shown in Table 7. (A correlation coefficient of 1.00 and R-squared value of 100 percent indicates the best relationship.)

There were no strong direct correlations between THM concentrations at the Interagency Delta Health Aspects Monitoring Program sampling stations and the 5-day average DAYFLOW model parameters. The poor correlations may be attributed to the distance and locations of the stations relative to the DAYFLOW point sources or regions modeled. More likely, the poor correlations suggest that local environmental conditions may have a greater influence on water quality at the monitoring stations. These local conditions may include agricultural drainage, riparian and aquatic vegetation, channel bottom material, and algal productivity.

Correlations were strongest between EC values and total bromomethane formation potential concentrations. This suggests that inorganic constituents (bromides) have a strong effect on total bromomethane formation potential and total THM formation potential at some stations. The DWR Bryte Laboratory has not been able to measure bromides under 1 mg/L (1,000 ug/L). Consequently, a correlation between bromide concentrations and other water quality parameters could not be determined.

Table 2
FREQUENCY OF TOTAL TRIHALOMETHANE FORMATION POTENTIAL VALUES
July 1983 to December 1987

Range (ug/L)	American R	Sacto R/ Greene's	Lindsey Slough	Connection Sl	Middle River	SJR at Vernalis	Rock Slough	Clifton Court	Banks PP	Delta-Mendota	Mallard Island	Grand Ag Dr	Tyler Ag Dr	Empire Ag Dr
100 and less	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101-200	15	8	0	1	0	0	0	1	0	0	0	0	0	0
201-300	22	24	1	6	0	4	2	0	0	2	0	1	0	0
301-400	5	9	2	10	7	16	15	10	11	12	0	1	0	0
401-500	-	5	1	2	9	9	11	16	15	15	1	1	0	0
501-600	-	0	0	0	4	11	8	9	7	5	4	0	0	0
601-700	-	2	4	2	4	7	4	5	8	6	2	1	0	0
701-800	-	1	2	3	1	3	3	2	5	3	2	0	0	0
801-900	-	0	6	1	2	0	-	0	1	-	5	4	1	0
901-1000	-	0	5	0	-	0	-	1	1	-	4	2	0	1
1001-1100	-	2	3	0	-	0	-	-	0	-	4	1	1	1
1101-1200	-	-	1	0	-	1	-	-	0	-	1	0	0	1
1201-1300	-	-	4	0	-	-	-	-	0	-	1	3	1	1
1301-1400	-	-	2	0	-	-	-	-	0	-	1	2	3	0
1401-1500	-	-	0	1	-	-	-	-	0	-	-	4	1	1
1501-1600	-	-	1	-	-	-	-	-	0	-	-	0	1	1
1601-1700	-	-	0	-	-	-	-	-	0	-	-	0	2	1
1701-1800	-	-	0	-	-	-	-	-	0	-	-	2	0	1
1801-1900	-	-	0	-	-	-	-	-	0	-	-	1	1	0
1901-2000	-	-	0	-	-	-	-	-	1	-	-	2	0	0
2001-2100	-	-	0	-	-	-	-	-	-	-	-	0	0	0
2101-2200	-	-	0	-	-	-	-	-	-	-	-	2	3	1
2201-2300	-	-	1	-	-	-	-	-	-	-	-	0	2	2
2301-2400	-	-	0	-	-	-	-	-	-	-	-	0	2	1
2401-2500	-	-	0	-	-	-	-	-	-	-	-	2	0	0
2501-2600	-	-	0	-	-	-	-	-	-	-	-	0	0	0
2601-2700	-	-	0	-	-	-	-	-	-	-	-	0	0	1
2701-2800	-	-	1	-	-	-	-	-	-	-	-	0	0	1
2801-2900	-	-	-	-	-	-	-	-	-	-	-	0	0	0
2901-3000	-	-	-	-	-	-	-	-	-	-	-	1	0	1
2001-3100	-	-	-	-	-	-	-	-	-	-	-	0	0	2
3101-3200	-	-	-	-	-	-	-	-	-	-	-	0	0	2
3201-3300	-	-	-	-	-	-	-	-	-	-	-	0	0	0
3301-3400	-	-	-	-	-	-	-	-	-	-	-	1	0	2
3401-3500	-	-	-	-	-	-	-	-	-	-	-	0	0	5
3501-3600	-	-	-	-	-	-	-	-	-	-	-	0	1	1
3601-3700	-	-	-	-	-	-	-	-	-	-	-	1	0	0
3701-3800	-	-	-	-	-	-	-	-	-	-	-	-	0	0
3801-3900	-	-	-	-	-	-	-	-	-	-	-		0	0
3901-4000	-	-	-	-	-	-	-	-	-	-	-		0	1
4001-4100	-	-	-	-	-	-	-	-	-	-	-		1	3
4101-4200	-	-	-	-	-	-	-	-	-	-	-		0	-
4201-4300	-	-	-	-	-	-	-	-	-	-	-		1	-

Station	Location
American R	American River Water Treatment Plant
Sacto R/Greene's	Sacramento River at Greene's Landing
Lindsey Slough	Lindsey Slouth at Hastings Cut
Connection Sl	Little Connection Slough .at Empire Tract
Middle River	Middle River at Borden Highway
SJR at Vernalis	San Joaquin River at Vernalis
Rock Slough	Rock Slough at Old River
Clifton Court	Clifton Court Forebay Intake
Banks PP	Banks Pumping Plant Headworks
Delta-Mendota	Delta-Mendota Canal Intake
Mallard Island	Sacramento River at Mallard Island
Grand Ag Dr	Agricultural Drain on Grand Island
Tyler Ag Dr	Agricultural Drain on Tyler Island
Empire Ag Dr	Agricultural Drain on Empire Tract

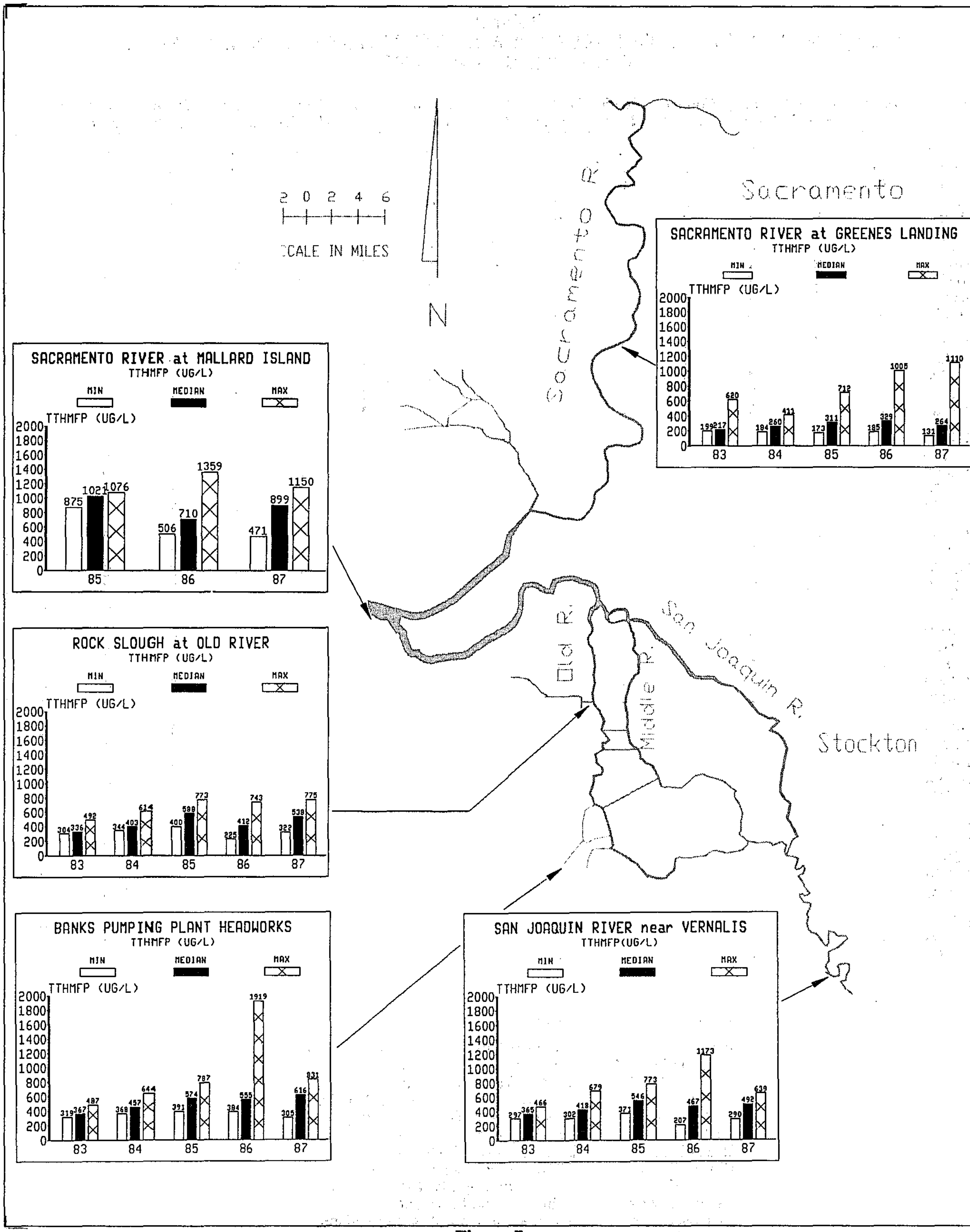
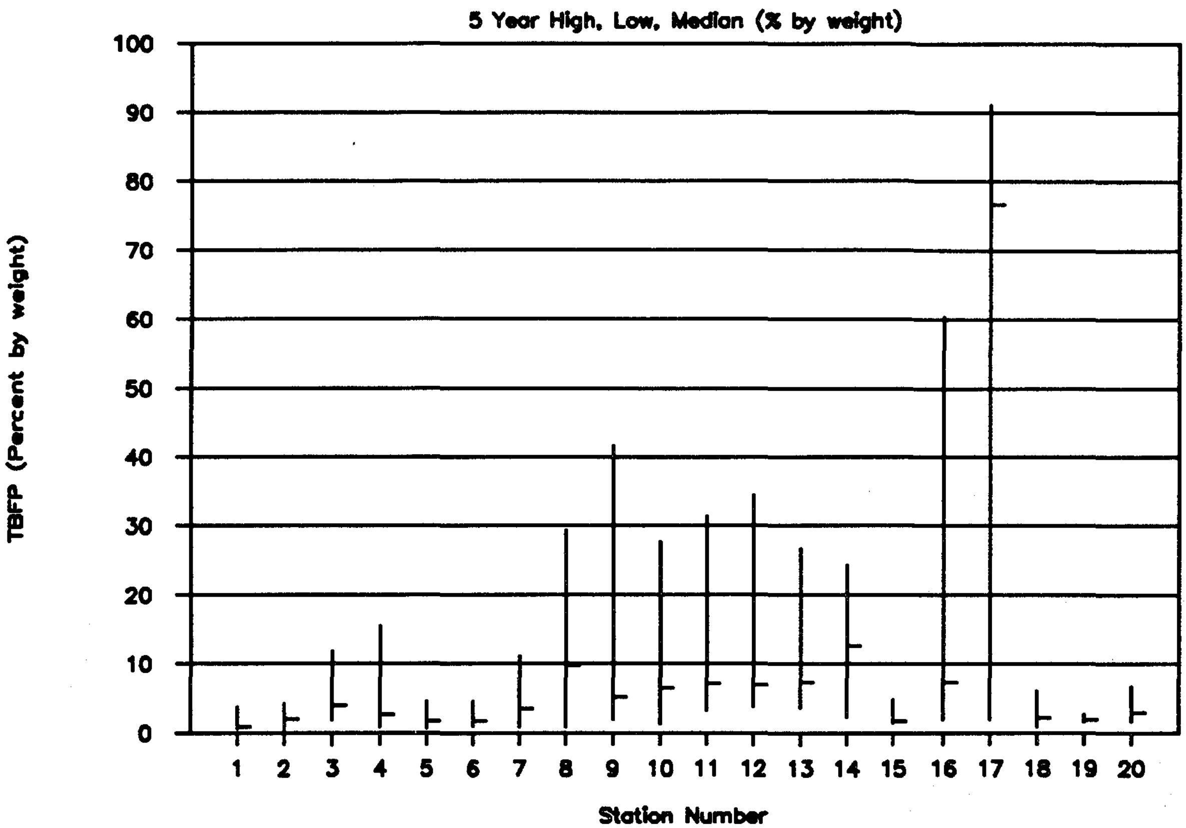


Figure 7
TOTAL THM FORMATION POTENTIAL IN THE DELTA
1983-1987 LOWEST, MEDIAN, HIGHEST



Station Number	Station Name
1	American River at Water Treatment Plant
2	Sacramento River at Greene's Landing
3	Cache Slough at Vallejo Pumping Plant
4	Lindsey Slough at Hastings Cut
5	Agricultural Drain at Grand Island
6	Agricultural Drain at Tyler Island
7	Little Connection Slough at Empire Tract
8	Agricultural Drain at Empire Tract
9	Rock Slough at Old River
10	Clifton Court Forebay Intake
11	Delta-Mendota Canal Intake
12	Banks Pumping Plant Headworks
13	Middle River at Borden Highway
14	San Joaquin River at Vernalis
15	Lake Del Valle Stream Release
16	Mallard Slough at Contra Costa Water District Pumping Plant
17	Sacramento River at Mallard Island
18	North Bay Interim Pumping Plant Intake
19	Barker Slough at Pumping Plant
20	Agricultural Drain at Natomas Main Drain

Figure 8
TOTAL BROMOMETHANE FORMATION POTENTIAL,
5-YEAR HIGH, LOW, MEDIAN

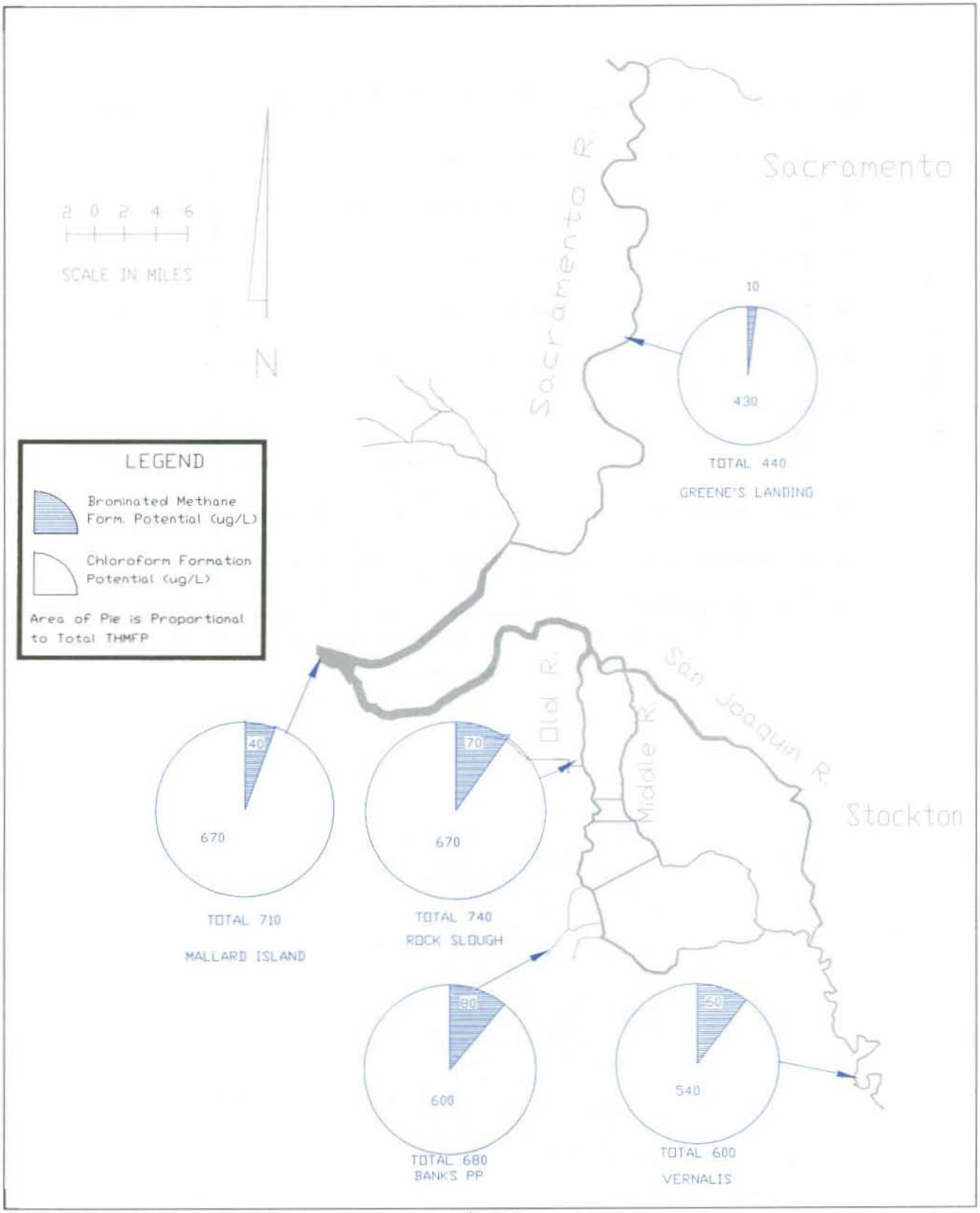


Figure 9
TOTAL BROMOMETHANE FORMATION POTENTIAL IN THE DELTA
UNDER HIGH FLOW CONDITIONS, MARCH 1986

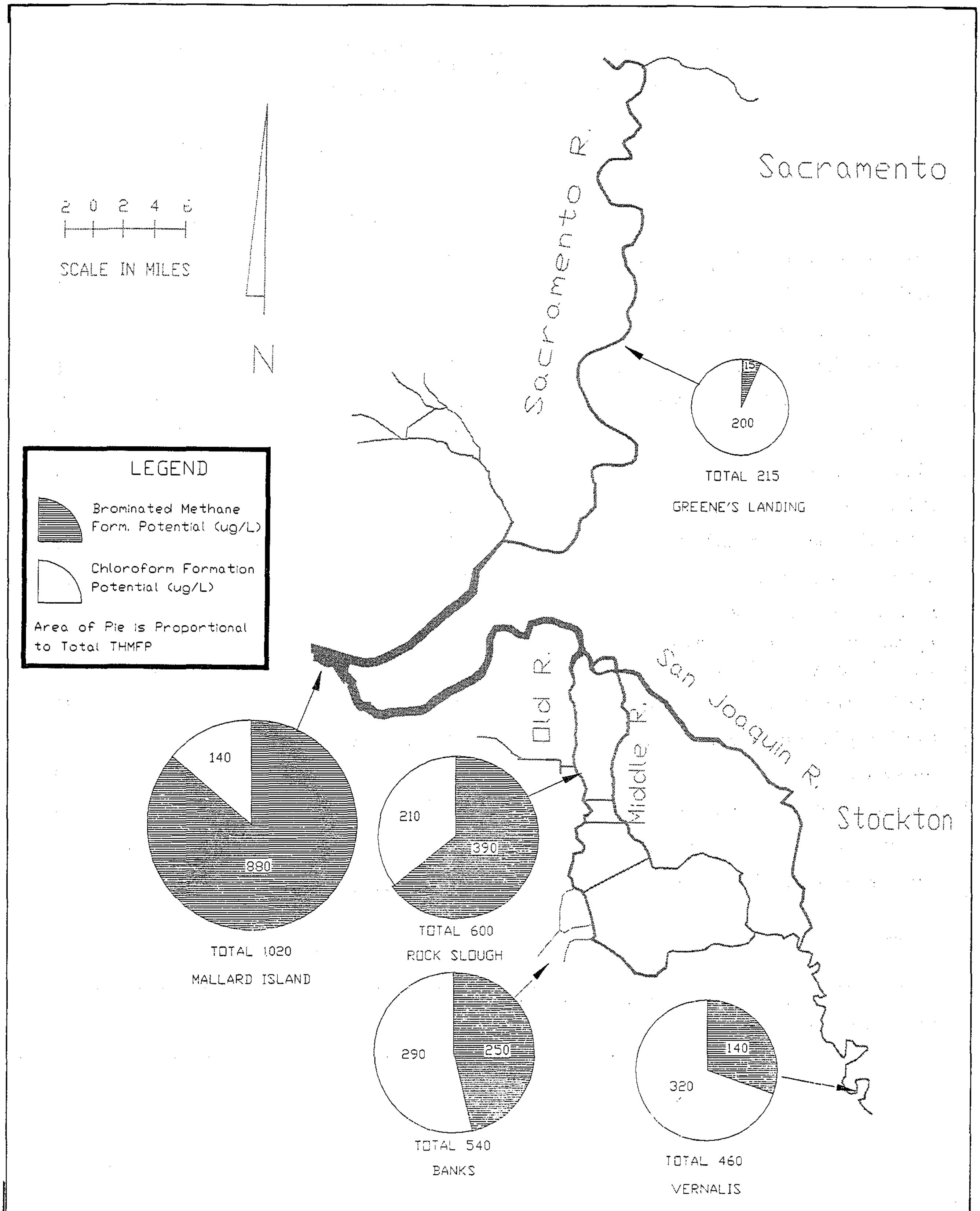


Figure 10
TOTAL BROMOMETHANE FORMATION POTENTIAL IN THE DELTA
UNDER LOW FLOW CONDITIONS, OCTOBER 1985

Table 3
FREQUENCY OF SELENIUM CONCENTRATIONS
1984 - 1987
Interagency Delta Health Aspects Monitoring Program

Station	ND*	Range of Concentrations (ug/L) 1	2	3**	Total Samples
Agricultural Drain at Empire Tract	10	1	-	-	11
Agricultural Drain at Grand Island	13	1	-	-	14
Agricultural Drain at Tyler Island	7	-	-	-	7
American River at Water Treatment Plant	5	-	-	-	5
H.O. Banks Delta Pumping Plant	24	3	1	1	29
Cache Slough at Vallejo Pumping Plant	1	5	-	-	6
Clifton Court Intake	17	4	-	-	21
Delta-Mendota Canal Intake	21	8	2	1	32
Lake Del Valle Stream Release	2	-	-	-	2
Lindsey Slough at Hastings Cut	22	-	-	-	22
Little Connection Slough	1	1	-	-	2
Mallard Slough at Contra Costa Water District Pumping Plant	2	-	-	-	2
Middle River at Borden Highway	7	3	-	-	10
North Bay Interim Pumping Plant	8	1	-	-	9
Rock Slough at Old River	16	1	-	-	17
Sacramento River at Greene's Landing	20	2	-	-	22
Sacramento River at Mallard Island	12	-	-	-	12
San Joaquin River at Vernalis	11	15	6	2	34
Totals	199	45	9	4	257

* ND = Not detected at 1 ug/L detection limit.
** Selenium did not exceed 3 ug/L at any of these locations.

Table 4
FREQUENCY OF SODIUM CONCENTRATIONS
1983 - 1987
Interagency Delta Health Aspects Monitoring Program

Station	Range Of Concentrations (mg/L) <20	20-99	≥100	Total Samples
Agricultural Drain at Empire Tract	0	14	19	33
Agricultural Drain at Grand Island	4	30	0	34
Agricultural Drain at Tyler Island	6	17	0	23
American River at Water Treatment Plant	45	0	0	45
Banks Pumping Plant	2	51	2	55
Clifton Court Intake	4	47	2	53
Delta-Mendota Canal Intake	2	49	1	52
Lindsey Slough at Hastings Cut	0	44	0	44
Little Connection Slough	27	3	0	30
Middle River at Borden Highway	0	31	0	31
North Bay Aqueduct Interim Pumping Plant	47	0	0	47
Rock Slough at Old River	13	34	7	54
Sacramento River at Greene's Landing	54	0	0	54
Sacramento River at Mallard Island	2	1	26	29
San Joaquin River at Vernalis	4	46	3	53

Table 5
PESTICIDE MONITORING RESULTS, 1983-1987
Interagency Delta Health Aspects Monitoring Program

Chemical	Times Sampled	Times Detected	Highest Concentration (ug/L)	Location (Found Above Detection Limit Once At Each Location Unless Noted)	Drinking Water Standards* (ug/L)
2,4-D	83	6	1.0	BR, BN, L, AGE(2), CS	70(PFMCL); 100(SMCL)
4,4'-DDD	47	1	0.004	V	
4,4'-DDE	47	2	0.007	V, RS	
4,4'-DDT	47	0			
Alachlor	21	0			0.2(LOQ)
Aldrin	47	0			0.05(LOQ)
Atrazine	17	1	0.18	AGE	3(PFMCL); 3(SMCL)
Bentazon	71	8	2.8	GR(2), AGE, V, BN(2), RS, AGT	18(SMCL)
BHC-alpha	60	4	0.003	V, DMC, CS, CC	
BHC-beta	47	3	0.006	V, DMC, CC	
BHC-gamma	47	13	0.006	L, GR, DMC, RS(2), CS, MO(2), H(2), NB, CC(2)	
BHC-delta	47	0			
Bolero (thiobencarb)	87	2	1.7	AGG, V	70(SMCL)
Captan	21	0			350(SAL)
Carbaryl	18	0			60(SAL)
Carbofuran	96	2	1.33	V, CS	40(PFMCL); 18(PSMCL)
Chlordane	47	0			0.1 (PSMCL)
Chloropicrin	59	0			50(SAL)
Copper Dacthal	21	0			
D-D Mixture	29	0			
Dacthal	51	1	0.15	AGG	
Diazinon	45	8	0.1	V, BN, DMC, RS(2), CS, NB, CC	14(SAL)
Dichlorovos	23	0			
Dicofol	21	0			
Dieldrin	47	3	0.005	V, DMC, CC	0.05(LOQ)
Dimethoate	23	1	0.046	V	140(SAL)
Dinoseb	21	0			
Diphenamid	23	0			
Diquat	18	0			
Disulfoton	41	0			
Dithiocarbamate	18	0			
Endosulfan 01	35	1	0.004	V	
Endosulfan 02	38	4	0.005	DMC, RS, CS, CC	
Endosulfan	47	2	0.01	V, RS	
Endosulfan-A	12	0			
Endosulfan-B	12	0			
Endrin	47	0			
Endrin Aldehyde	47	0			
Ethion	23	0			
Glyphosate	6	1	10.0	AGE	700(SAL)
Guthion	23	1	0.02	RS	
Heptachlor	47	0			0.4(PFMCL); 0.01(SAL); 0.01(PSMCL)
Heptachlor Epoxide	47	0			0.01(PSMCL)
Malathion	23	0			160(SAL)
MCPA	55	0			
Metalaxyl	51	0			
Methamidophos	45	0			
Methomyl	18	0			
Methyl Bromide	29	0			
Methyl Parathion	82	6	2.5	V(2), DMC, RS, CS, CC	30(SAL)
Ordram (molinate)	69	14	1.4	MA, L, GR, AGG, AGE(2), V(2), BN(2), DMC, RS(2), MI	20(SMCL)
Paraquat	72	2	74.0	V(2)	
Parathion	45	6	0.035	V, DMC, RS(2), CS, CC	30 (SAL)
PCB-1216	12	0			0.5(PFMCL)
PCB-1221	12	0			0.5 (PFMCL)
PCB-1232	12	0			0.5 (PFMCL)
PCB-1242	12	0			0.5 (PFMCL)
PCB-1248	12	0			0.5 (PFMCL)
PCB-1254	12	0			0.5 (PFMCL)
PCB-1260	12	0			0.5 (PFMCL)
Propanil	16	0			
Propham	18	0			
Simazine	17	2	0.36	DMC(2)	10(SMCL)
Toxaphene	47	0			5(PFMCL); 5(SMCL)
Xylene	29	0			440 (FMCLG); 1750(SMCL)

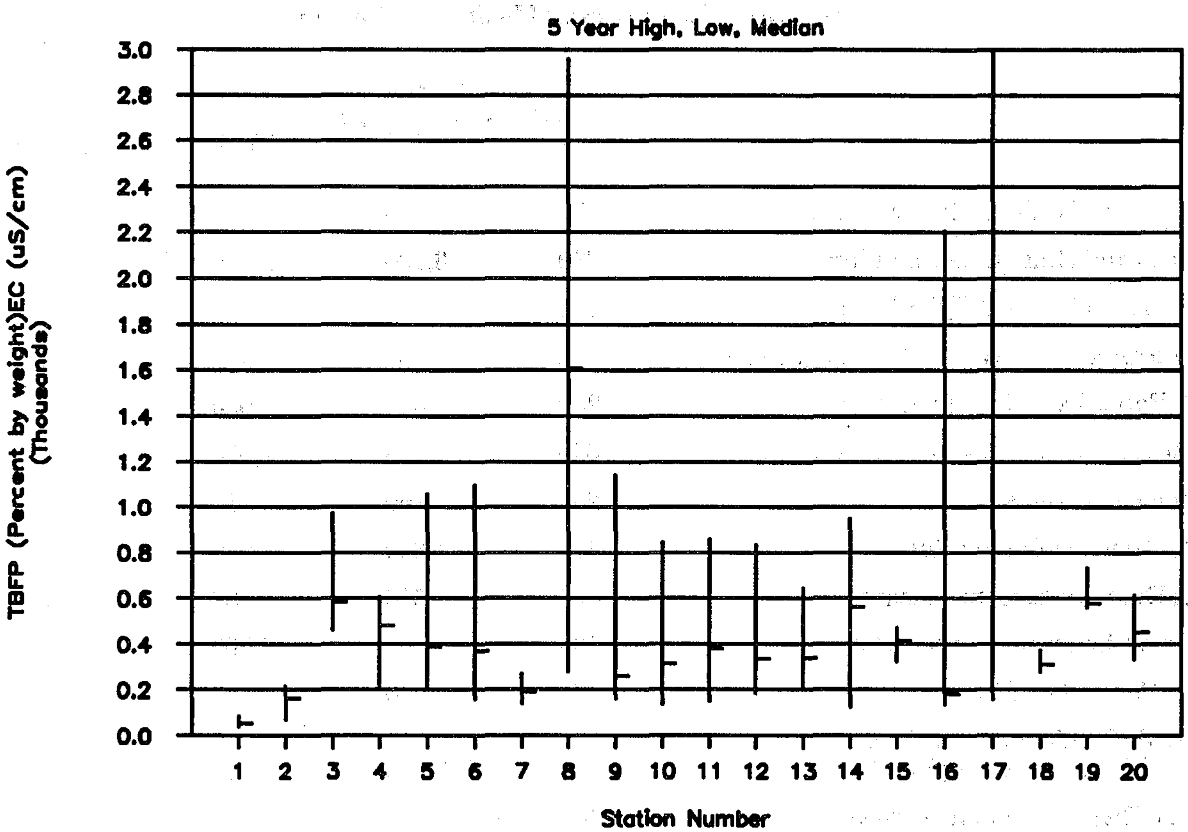
* PFMCL = Proposed Federal Maximum Contaminant Level
FMCLG = Federal Maximum Contaminant Level Goal
PSMCL = Proposed State Maximum Contaminant Level
SMCL = State Maximum Contaminant Level
SAL = State Action Level
LOQ = Limit of Quantification

LOCATION ABBREVIATIONS
AGE = Agricultural Drain at Empire Tract
AGG = Agricultural Drain at Grand Island
AGT = Agricultural Drain at Tyler Island
BN = Banks Pumping Plant
BR = Barker Slough
CC = Clifton Court
CS = Cache Slough
DMC = Delta-Mendota Canal
GR = Greene's Landing
H = Honker Cut
L = Lindsey Slough
MA = Mallard Island
MI = Middle River
MO = Mokelumne River
NB = North Bay Pumping Plant
RS = Rock Slough
V = Vernalis

Table 6
RESULTS OF ASBESTOS SAMPLING
1984 - 1986
Interagency Delta Health Aspects Monitoring Program

Station	Total Asbestos Fibers (Million Fibers per Liter) Low	High	Median	Number of Samples
Agricultural Drain at Empire Tract	76	300	92	3
Agricultural Drain at Grand Island	630	3,100	2,100	3
Agricultural Drain at Tyler Island	190	530	410	3
American River at Water Treatment Plant	12	2,200	110	18
H.O. Banks Delta Pumping Plant	230	1,400	625	8
Cache Slough at Vallejo Pumping Plant	650	4,000	1,550	8
Clifton Court Intake	230	960	510	16
Delta-Mendota Canal Intake	370	1,800	700	15
Lake Del Valle Stream Release	50	570	59	5
Lindsey Slough at Hastings Cut	1,160	7,500	3,500	5
Little Connection Slough	68	220	140	3
Mallard Slough at Contra Costa Water District Pumping Plant	510	*26,000	1,040	6
Middle River at Borden Highway	100	540	210	3
North Bay Interim Pumping Plant	180	6,000	1,150	16
Rock Slough at Old River	140	1,500	565	16
Sacramento River at Greene's Landing	110	3,200	380	15
Sacramento River at Mallard Island	240	3,490	1,865	2
San Joaquin River at Vernalis	270	3,300	870	17

*Suspect data, perhaps due to laboratory dilution error. Laboratory unable to verify error.



Station Number	Station Name
1	American River at Water Treatment Plant
2	Sacramento River at Greene's Landing
3	Cache Slough at Vallejo Pumping Plant
4	Lindsey Slough at Hastings Cut
5	Agricultural Drain at Grand Island
6	Agricultural Drain at Tyler Island
7	Little Connection Slough at Empire Tract
8	Agricultural Drain at Empire Tract
9	Rock Slough at Old River
10	Clifton Court Forebay Intake
11	Delta-Mendota Canal Intake
12	Banks Pumping Plant Headworks
13	Middle River at Borden Highway
14	San Joaquin River at Vernalis
15	Lake Del Valle Stream Release
16	Mallard Slough at Contra Costa Water District Pumping Plant
17	Sacramento River at Mallard Island
18	North Bay Interim Pumping Plant Intake
19	Barker Slough at Pumping Plant
20	Agricultural Drain at Natomas Main Drain

Figure 11
ELECTRICAL CONDUCTIVITY,
5-YEAR HIGH, LOW, MEDIAN

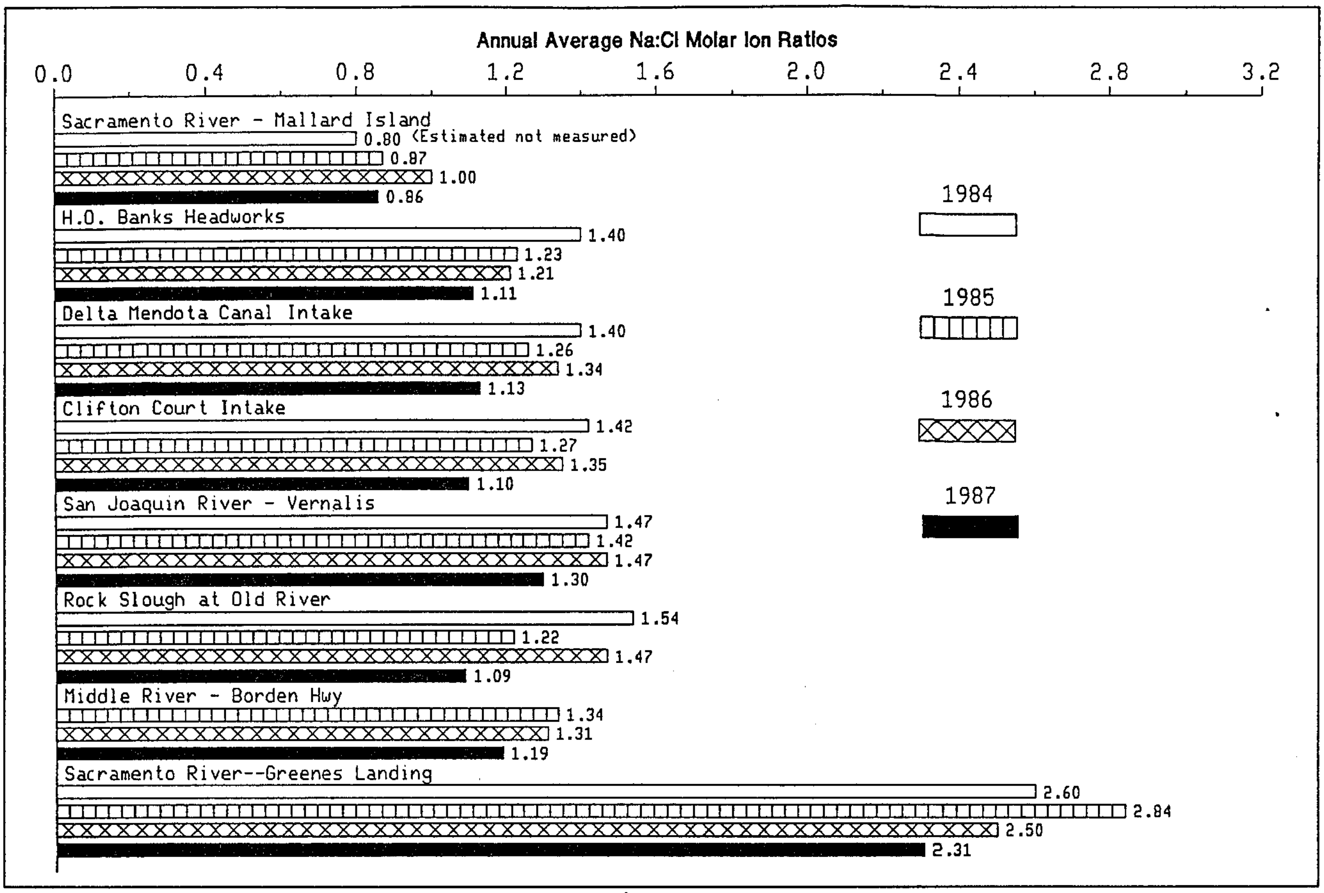


Figure 12
MOLAR SODIUM TO CHLORIDE ION RATIOS, 1984-1987

Table 7
SIMPLE LINEAR REGRESSION VALUES
(R-Squared Values)

Station	EC vs. Flow	Na:Cl vs. EC	TBFP vs. EC	TBFP vs. Flow	TTHMFP vs. Flow
American River at Water Treatment Plant	7. (SAC5)			3. (SAC5)	8. (SAC5)
Sacramento River at Greene's Landing	54. (SAC5)	0	40.	14. (SAC5)	0. (SAC5)
Cache Slough at Vallejo Pumping Plant	49. (SAC5)		85.	29. (SAC5)	
Lindsey Slough at Hastings Cut			30.		
Ag. Drain, Grand Island	17. (TOT5) 35. (SAC5)	36.	60.		
Ag. Drain, Tyler Island		60.	38.		
Little Connection Slough		9.	16.		
Ag. Drain, Empire Tract	7. (SAC5) 12. (OUT5)	39.	54.		
Rock Slough at Old River	5. (TOT5) 5. (OUT5) 8. (SAC5)	51.	92.	6. (OUT5)	1. (OUT5)
Clifton Court Forebay Intake	13. (TOT5) 13. (OUT5)	67.	75.	9. (OUT5)	0. (OUT5)
Delta-Mendota Canal Intake	12. (OUT5)	38.	75.	11. (OUT5)	0. (OUT5)
Banks Pumping Plant Headworks	8. (OUT5)	45.	76.		
Middle River at Borden Highway		44.	33.		
San Joaquin River at Vernalis	57. (SJR5)	36.	84.	48. (SJR5)	3. (SJR5)
Sacramento River at Mallard Island	21. (TOT5) 21. (OUT5) 21. (SAC5)	32.	36.	43. (TOT5) 45. (OUT5)	10. (TOT5) 11. (OUT5)
North Bay Interim Pumping Plant		1.	12.		

SAC5 = DAYFLOW Sacramento River 5-day average
TOT5 = Total computed DAYFLOW Delta Inflow 5-day average
OUT5 = DAYFLOW net Delta outflow 5-day average
SJR5 = DAYFLOW San Joaquin River 5 day average
Na:Cl = Molar ratio of sodium to chloride ion concentrations
EC = Electrical conductivity readings
TBFP = Total brominated methane formation potential by weight
TTHMFP = Total trihalomethane formation potential by weight

Chapter 4
FUTURE WATER QUALITY CONSIDERATIONS

The drinking water quality of Delta water supplies could change in the future as a result of natural disasters that could cause major flooding. New construction in the Delta could also affect water quality.

Natural Disasters

Levees are an integral part of the State and federal water projects in channeling water to the export pump facilities. They also protect against flooding in the Delta lowlands, which are below sea level. Major flooding can result in uncontrolled seawater intrusion deep into the Delta interior, which may be difficult to flush out. Of concern are the nonproject levees, many of which have inadequate freeboard and levee section, subsiding foundations, structurally weak peat soils, and other deficiencies. Hydraulic pressure from extremely high streamflows and earthquakes weakens the structural integrity of the levees.

An earthquake of Richter magnitude 7 or greater centered in the San Francisco Bay area is capable of causing the liquefaction of a supporting toe berm on Twitchell Island's Threemile Slough levee and the flooding of the below sea level islands *(Sacramento Area Regional Planning Commission, 1976).*

Delta Flood Protection Act

The Delta Flood Protection Act of 1988 (Senate Bill 34) created the Delta Flood Protection Fund to make $12 million available each year for the next 10 years. Half will go to local assistance under the Delta Levee Maintanance Subventions Program. The other half is earmarked for special flood control projects for eight western Delta islands and the towns of Walnut Grove and Thornton.

Major changes include revamping the Subventions Program, which provides funds for local reclamation districts to maintain and improve the levees within their boundaries.

Proposed Construction Projects

One proposal undergoing extensive environmental study is the Delta Wetlands Project, which would flood four islands to store about 400,000 acre-feet of water, which would be sold to water users. Another plan under consideration includes relocating the Clifton Court Forebay intake gates.

Delta Wetlands Project

Delta Wetlands Corporation is proposing to create water storage reservoirs to impound high winter flows on Bouldin, Webb, Holland, and Bacon islands. The water would later be released for export by the State Water Project. A project of this magnitude could have tremendous effect on the quality of Delta water. One concern is whether THM precursor concentrations would be increased in the water released from the islands.

Islands in the proposed project have peat soils, which are known to be sources of THM precursors. Flooded peat soils could contribute THM precursors to water stored on the islands. It is also possible that flooding would stabilize the soils and reduce their contribution of THM precursors to Delta channels. An environmental impact study is underway, and numerous permits must be obtained from a variety of agencies. The THM issue is among those to be resolved.

Clifton Court Forebay Intake

Several problems in the southern Delta affect channel water quality: low water levels, poor channel circulation, and increased salinity from drainage discharge. These conditions are aggravated by the Central Valley Project and State Water Project diversions during high tides. One proposed measure to alleviate these problems involves expanding Clifton Court Forebay and adding a new intake gate at the north end, near Victoria Canal. Although these modifications may improve south Delta water quality, it is unknown if the quality of water taken into Clifton Court will be affected.

A special Interagency Delta Health Aspects Monitoring Program study of mineral quality in Old River and Middle River in the vicinity of the proposed new intake indicated a highly saline source of water near Victoria Canal in the fall of 1986. A combination of San Joaquin River and local drainage is the suspected source. Samples for trihalomethane formation were not collected, so there are no data to indicate whether there might also be a high THM precursor source.

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Appendix A
SUMMARY OF MONITORING, JULY 1986 THROUGH DECEMBER 1987

This appendix presents results of monitoring during the third 18-month period of the Interagency Delta Health Aspects Monitoring Program. Data from the full 5-year period are presented in Appendix G.

Total Trihalomethane Formation Potential

Figure A-1 depicts the high, low, and median values collected from July 1986 through December 1987. During this time, the highest median values of total THM formation potential were at Grand Island (1,404 ug/L), Tyler Island (1,651 ug/L) and Empire Tract (2,700 ug/L). Lowest median values were at the American River (214 ug/L), Sacramento River (238 ug/L), and the North Bay Interim Pumping Plant (276 ug/L). Median values at the export stations ranged from 468 to 565 ug/L. Median values, as opposed to average values, are shown because the median is a more reliable estimate of central tendency where normal frequency distribution of the data cannot be assured because of the small sample size.

Total THM formation potential median values for the third 18-month period were compared to those for the first 3-1/2 years of the 5-year study. The number of data points (ranging from 11 to 16 points per station) for the third 18-month period were not sufficient at any station to perform a statistically valid analysis.

Total Bromomethane Formation Potential

Results of analyses were evaluated for percent total bromomethane formation potential based on median values for the 18-month period. Samples from the Sacramento River at Mallard Island contained 92 percent brominated THM species; San Joaquin River at Vernalis samples contained 39 percent; and DMC Intake samples contained 30 percent. Samples from Sacramento River at Greene's Landing, American River at the Water Treatment Plant, Lindsey Slough at Hastings Cut and North Bay Interim Pumping Plant, contained less than 10 percent brominated species. The agricultural drains on Grand, Tyler, and Empire Tracts contained less than 20 percent. The high concentrations of total bromomethane formation potential at the Sacramento River at Mallard Island demonstrates the influence of sea water containing bromides.

Selenium

Selenium concentrations in water did not exceed the current drinking water MCL of 10 ug/L during this 18-month monitoring period. Selenium concentrations ranged from below the detection limit of 1 ug/L to 3 ug/L, and most samples had undetectable levels. Maximum values of 3 ug/L were found at the Delta-Mendota Canal intake (once), Banks Pumping Plant (once) and San Joaquin River at Vernalis (twice) during the 18-month period.

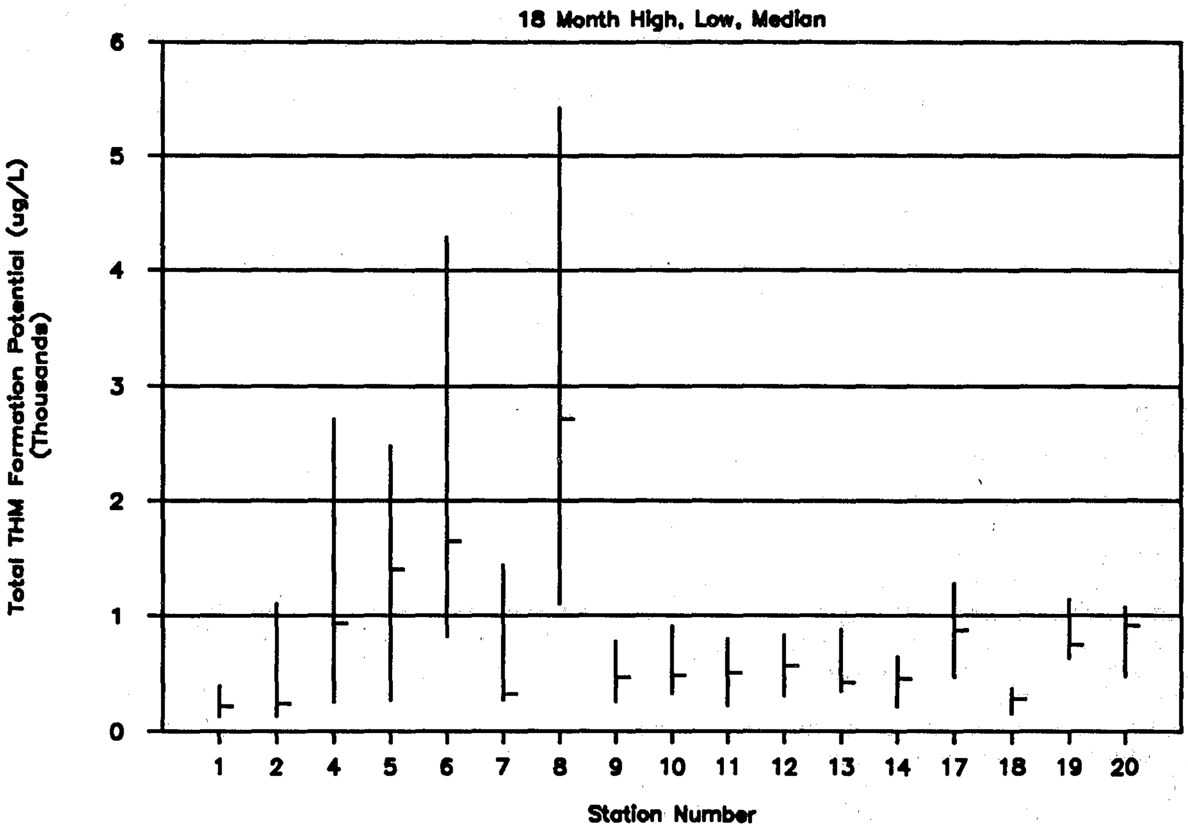
Sodium

Median sodium values ranged from 2 to 73 mg/L except for samples collected from the Sacramento River at Mallard Island, which showed a median value of 1,090 mg/L. Sacramento River at Mallard is predominantly influenced by sea water, which has naturally high concentrations of sodium. This water is used as a drinking water source only when EC is low.

Median sodium concentrations were below 20 mg/L NAS advisory at the American River, Sacramento River at Greene's Landing, Little Connection Slough at Empire Tract, and North Bay Interim Pumping Plant Intake.

Pesticides

Individual pesticide concentrations detected in water during the 18-month period were compared to State and Federal drinking water standards and criteria. Concentrations were far below health concern levels. Those pesticides slightly above detection levels were 2,4-D, atrazine, bentazon, bolero, dacthal, glyphosate, ordram, and simazine.



NOTE: No data were collected at Stations 3, 15, and 16 during this reporting period.

Station Number	Station Name
1	American River at Water Treatment Plant
2	Sacramento River at Greene's Landing
3	Cache Slough at Vallejo Pumping Plant
4	Lindsey Slough at Hastings Cut
5	Agricultural Drain at Grand Island
6	Agricultural Drain at Tyler Island
7	Little Connection Slough at Empire Tract
8	Agricultural Drain at Empire Tract
9	Rock Slough at Old River
10	Clifton Court Forebay Intake
11	Delta-Mendota Canal Intake
12	Banks Pumping Plant Headworks
13	Middle River at Borden Highway
14	San Joaquin River at Vernalis
15	Lake Del Valle Stream Release
16	Mallard Slough at Contra Costa Water District Pumping Plant
17	Sacramento River at Mallard Island
18	North Bay Interim Pumping Plant Intake
19	Barker Slough at Pumping Plant
20	Agricultural Drain at Natomas Main Drain

Figure A-1
TOTAL THM FORMATION POTENTIAL

Appendix B
CLIFTON COURT FOREBAY WATER QUALITY ANALYSIS

Data were examined to assess water quality changes that might be attributable to biological productivity and mixing in Clifton Court Forebay, a storage facility for Delta water pumped by the State Water Project. The shallow forebay averages about 30 feet deep and has a storage capacity of 31,000 acre-feet. Water enters Clifton Court Forebay via intake gates operated by the Department of Water Resources and is pumped from the forebay at the Harvey O. Banks Delta Pumping Plant headworks.

Daily pumped volumes and monthly water quality data collected from the intake and headworks were examined. Daily flow data were used to calculate monthly exchange rates and water residence times in the forebay. Daily flow records showed that pumping from and inflow to the forebay were closely synchronized and about equal in volume to achieve nearly steady state.

Statistical computations were made to compare flow volumes by month. Daily low, high, average, and standard deviations were computed by month. However, because of the large range of daily flows within some months, the average values, monthly exchange rates, and water residence times may not accurately reflect true operating conditions in the forebay for that particular month.

Table B-1 shows the daily low, high, total, and mean low for each month at both the intake and the headworks. Average monthly exchanges of water and residence time of forebay water are also included in the table. Water residence time was estimated by dividing the forebay volume (31,260 acre-feet) by the mean daily pumped volume. Exchange rate was estimated by dividing the monthly total volume pumped by the forebay volume.

Median residence time is about 5 days, and median volume of water exchanged per month about 5 acre-feet per day. The highly variable pumping schedule is reflected in the range of high and low daily volumes for some months. Pumping ceased on some days, and exchanged volumes were less than an acre-foot per day when there was no pumping for several days. For example, in April 1983 the total volume pumped was about 7,000 acre-feet. Molar ion ratios are presented in Figures B-1 and B-2. The figures show the months when bay water was exported more frequently during different water year types.

The effects of increased residence time of water in the forebay on SWP water quality was examined with the limited data available. There are no data for water samples taken inside the forebay. Analysis is, therefore, limited to data taken at the intake and headworks (outlet).

Figures B-3 and B-4 compare changes in total THM formation potential between the forebay intake and Banks Pumping Plant. Figures B-5 and B-6 show the percentage of chloroform in total THM formation potential analyses of monthly water samples at the two stations. Chloroform was chosen for study because the higher percentage (by weight) of chloroform indicate more fresh water in the forebay as brominated THMs tend to correlate with bromides from bay water intrusion.

At Banks and at the intake, the water quality in wet years 1982, 1983, 1984, and 1986 correlated with higher chloroform percentages (70 percent or more). Water quality in dry years 1985 and 1987 was associated with chloroform less than 70 percent in late summer and fall. The shifts from chloroform to more brominated THMs are attributed to shifts in amount of seawater ions, especially bromides, that are transported along with fresh water to the SWP pumps or are repelled by Delta outflow.

Total bromomethane formation potential and EC observations at the headworks had a correlation coefficient of 0.87 and R-squared value of 76.18 percent, as shown in Figure B-7. The correlation was statistically strong. The regression analysis yielded this relationship at Banks:

$$\text{TBFP (ug/L)} = -41.38 + (0.427)(\text{EC in uS/cm})$$

The total bromomethane formation potential to EC relationship at Clifton Court intake, as shown in Figure B-8, had a correlation coefficient of 0.867 and R-squared value of 75.21 percent. The relationship was:

$$\text{TBFP (ug/L)} = -28.69 + (0.36)(\text{EC in uS/cm})$$

Total THM formation potential to EC correlations were poor, with correlation coefficients of 0.24 (R-squared = 6.19 percent) at the headworks and 0.167 (R-squared = 2.80 percent) at the intake. Correlations with outflow data from the DWR DAYFLOW model also were poor.

In conclusion, while water at Banks Pumping Plant and Clifton Court Forebay met drinking water standards, the importance of Sacramento River flows as a freshwater supply and mechanism to repel baywater salts from entering the forebay were seen. During dry periods or low Delta outflow, forebay water contained more salts, as seen by EC and mineral analyses. During wet periods or higher Delta outflows, forebay water was more fresh. Total bromomethane formation potential could be expected to be less when forebay water quality is less saline.

Table B-1
DATA FOR CLIFTON COURT FOREBAY INTAKE AND BANKS PUMPING PLANT HEADWORKS
SORTED BY MEAN MONTHLY PUMPED VOLUME
(Units in Acre-Feet Per Day)

Station	Month	Year	Days	Lowest	Highest	Monthly Total	Mean	Standard Deviation	Volume Exchanges	Residence Time (Days)
CLIFTON	9	86	30	11480	14552	377110	12570	739	12.0	2.4
BANKS	9	86	30	11393	12647	374808	12494	299	11.9	2.5
BANKS	2	83	28	11008	12590	348240	12437	290	11.1	2.5
CLIFTON	2	83	28	9904	13686	344774	12313	880	11.0	2.5
CLIFTON	1	83	31	10104	14708	379641	12246	941	12.1	2.5
BANKS	1	83	31	7079	12583	376737	12153	970	12.0	2.5
BANKS	12	85	31	9015	12533	363212	11717	1105	11.6	2.6
CLIFTON	12	85	31	8909	13406	361574	11664	1080	11.5	2.6
CLIFTON	8	85	31	7518	13879	343355	11076	1839	10.9	2.8
BANKS	8	85	31	7739	12573	338299	10913	1796	10.8	2.8
CLIFTON	8	86	31	8442	13905	333425	10756	1370	10.6	2.9
BANKS	8	86	31	6858	12571	330595	10664	1295	10.5	2.9
CLIFTON	8	87	31	7645	12079	312007	10098	1234	9.98	3.0
CLIFTON	1	86	31	4028	13289	310129	10004	2779	9.92	3.1
BANKS	1	86	31	4263	12499	306504	9887	2836	9.80	3.1
CLIFTON	8	84	31	4528	11727	306239	9879	1484	9.79	3.1
BANKS	8	87	31	7968	12493	305233	9846	1243	9.76	3.1
BANKS	8	84	31	4726	12540	298591	9632	1530	9.55	3.2
BANKS	12	87	31	0	12629	298204	9619	4547	9.53	3.2
CLIFTON	12	87	31	0	15055	294839	9574	1651	9.43	3.2
CLIFTON	7	85	31	6942	10909	291093	9390	867	9.31	3.3
CLIFTON	7	84	31	6069	11207	286063	9228	966	9.15	3.3
CLIFTON	9	87	30	5936	13272	274578	9153	2114	8.78	3.4
BANKS	7	85	31	7733	12565	282768	9122	867	9.04	3.4
BANKS	9	87	30	5228	12496	272233	9074	2325	8.70	3.4
CLIFTON	3	85	31	3396	14967	280410	9045	3146	8.97	3.4
BANKS	7	84	31	5733	12571	279416	9013	1746	8.93	3.4
BANKS	3	85	31	3770	12561	277997	8968	2947	8.89	3.4
CLIFTON	9	85	30	4363	13030	266857	8895	2423	8.53	3.5
BANKS	9	85	30	5522	12549	265599	8853	2464	8.49	3.5
CLIFTON	12	84	31	1044	13329	273700	8829	3172	8.75	3.5
BANKS	12	84	31	2490	12489	273096	8810	3147	8.73	3.5
CLIFTON	7	87	31	3967	11107	269106	8681	1446	8.60	3.6
BANKS	7	87	31	5913	11500	265122	8552	1362	8.48	3.6
CLIFTON	7	86	31	4959	10552	247103	7971	1591	7.90	3.9
BANKS	11	84	30	5539	10342	238220	7941	1434	7.62	3.9
CLIFTON	11	84	30	4106	10137	238004	7933	1738	7.61	3.9
BANKS	7	86	31	3763	9440	239823	7736	1894	7.67	4.0
CLIFTON	4	84	30	3439	11291	218166	7272	1989	6.97	4.2
BANKS	4	84	30	4220	12528	214679	7156	2171	6.86	4.3

Table B-1 (continued)
DATA FOR CLIFTON COURT FOREBAY INTAKE AND BANKS PUMPING PLANT HEADWORKS
SORTED BY MEAN MONTHLY PUMPED VOLUME
(Units in Acre-Feet Per Day)

Station	Month	Year	Days	Lowest	Highest	Monthly Total	Mean	Standard Deviation	Volume Exchanges	Residence Time (Days)
CLIFTON	10	85	31	2492	10710	221591	7148	1672	7.08	4.3
BANKS	2	85	28	4248	10217	199502	7125	2007	6.38	4.3
BANKS	10	85	31	2535	10747	219658	7086	1620	7.02	4.4
CLIFTON	11	85	30	3556	13983	207350	6912	2915	6.63	4.5
CLIFTON	2	85	28	3769	10587	193150	6898	1761	6.17	4.5
BANKS	11	85	30	2699	12534	206499	6883	2870	6.60	4.5
CLIFTON	10	86	31	3148	13246	212169	6844	3435	6.78	4.5
CLIFTON	6	85	30	4921	10494	202413	6747	1366	6.47	4.6
BANKS	10	86	31	3097	12641	207921	6707	3452	6.65	4.6
CLIFTON	4	85	30	3572	9698	199821	6661	1666	6.39	4.6
BANKS	4	85	30	3699	9011	196817	6561	1658	6.29	4.7
BANKS	6	85	30	4814	10357	195529	6518	1348	6.25	4.7
CLIFTON	5	86	31	119	10607	195672	6312	2736	6.25	4.9
CLIFTON	12	86	31	120	10817	190724	6152	2163	6.10	5.0
CLIFTON	5	85	31	3894	8926	190232	6137	1489	6.08	5.0
CLIFTON	3	87	31	1302	11442	189905	6126	2003	6.07	5.1
BANKS	3	87	31	1043	12520	189646	6118	2471	6.06	5.1
CLIFTON	6	84	30	2564	10986	183147	6105	1660	5.85	5.1
BANKS	12	86	31	1462	10311	188133	6069	1994	6.01	5.1
BANKS	11	86	30	3324	8107	180820	6027	1519	5.78	5.1
CLIFTON	11	86	30	2382	8454	179676	5989	1538	5.74	5.2
BANKS	6	86	30	2457	10318	178455	5949	1883	5.70	5.2
BANKS	5	86	31	0	10322	184392	5948	2853	5.89	5.2
BANKS	6	84	30	3324	12524	178221	5941	2284	5.70	5.2
BANKS	5	85	31	2588	8896	184005	5936	1524	5.88	5.2
CLIFTON	5	84	31	0	11133	175868	5673	2358	5.62	5.5
CLIFTON	8	83	31	2462	10298	174166	5618	1771	5.57	5.5
BANKS	8	83	31	1418	10141	167707	5410	1797	5.36	5.7
BANKS	2	87	28	0	12570	151234	5401	2801	4.83	5.7
CLIFTON	2	87	28	281	10312	150327	5369	2299	4.80	5.8
BANKS	5	84	31	898	12550	164799	5316	2225	5.27	5.8
CLIFTON	3	84	31	2286	8950	158995	5129	1760	5.08	6.0
CLIFTON	4	87	30	1874	8251	153357	5112	1544	4.90	6.1
BANKS	4	87	30	2075	7767	153282	5109	1530	4.90	6.1
BANKS	3	84	31	1799	9453	157466	5080	1545	5.03	6.1
CLIFTON	9	84	30	1286	7391	134332	4478	1250	4.29	6.9
BANKS	9	84	30	1092	8239	131247	4375	1456	4.19	7.1
CLIFTON	5	87	31	1983	7041	134270	4331	1698	4.29	7.2
BANKS	1	87	31	161	8020	132326	4269	1775	4.23	7.3
CLIFTON	1	87	31	1177	6738	130759	4218	1490	4.18	7.4
CLIFTON	6	87	30	1365	7334	122307	4077	1622	3.91	7.6
BANKS	2	86	28	0	10321	112232	4008	2538	3.59	7.7
BANKS	4	86	30	0	10330	119661	3989	2864	3.82	7.8
BANKS	6	87	30	935	6994	118977	3966	1557	3.80	7.8
BANKS	5	87	31	1888	7883	122880	3964	1787	3.93	7.8

Table B-1 (continued)
DATA FOR CLIFTON COURT FOREBAY INTAKE AND BANKS PUMPING PLANT HEADWORKS
SORTED BY MEAN MONTHLY PUMPED VOLUME
(Units in Acre-Feet Per Day)

Station	Month	Year	Days	Lowest	Highest	Monthly Total	Mean	Standard Deviation	Volume Exchanges	Residence Time (Days)
CLIFTON	6	83	30	0	8664	117479	3916	2038	3.75	7.9
BANKS	2	84	29	369	7255	113226	3904	1568	3.62	8.0
CLIFTON	1	85	31	1670	6669	116698	3764	1323	3.73	8.3
CLIFTON	2	84	29	660	7225	108668	3747	1574	3.47	8.3
BANKS	1	85	31	978	7233	115619	3730	1436	3.69	8.3
BANKS	10	84	31	13	12344	114926	3707	2805	3.67	8.4
CLIFTON	10	84	31	0	12803	114800	3703	2985	3.67	8.4
CLIFTON	4	86	30	0	8778	110833	3694	2801	3.54	8.4
BANKS	6	83	30	49	10389	108167	3606	2071	3.46	8.6
CLIFTON	10	87	31	0	7519	107969	3483	1576	3.45	8.9
BANKS	10	87	31	0	9246	104091	3358	1982	3.32	9.3
CLIFTON	6	86	30	1981	9558	182136	3071	1716	5.82	10.
CLIFTON	11	87	30	0	5154	81917	2731	1499	2.62	11.
BANKS	11	87	30	0	6696	81555	2719	1709	2.60	11.
CLIFTON	3	83	31	0	15207	83158	2683	4380	2.66	11.
BANKS	3	83	31	0	12568	82716	2668	3922	2.64	11.
CLIFTON	2	86	28	9018	114465	4088	2406	0.13	12.	
CLIFTON	7	83	31	0	8003	72201	2329	2002	2.30	13.
BANKS	7	83	31	0	10423	70424	2272	2364	2.25	13.
CLIFTON	9	83	30	0	5532	45485	1516	1479	1.45	20.
BANKS	11	83	30	129	3996	44719	1491	1358	1.43	20.
CLIFTON	11	83	30	0	5012	43585	1453	1530	1.39	21.
BANKS	3	86	31	0	10370	44645	1440	2280	1.42	21.
CLIFTON	3	86	31	0	7492	43402	1400	2199	1.38	22.
BANKS	9	83	30	61	4025	39978	1333	1131	1.27	23.
CLIFTON	12	83	31	0	5334	29753	960	1345	0.95	32.
BANKS	12	83	31	0	2596	25954	837	723	0.83	37.
CLIFTON	5	83	31	0	3644	24817	801	1220	0.79	39.
BANKS	5	83	31	0	3245	23782	767	1079	0.76	40.
CLIFTON	10	83	31	0	2521	21132	682	847	0.67	45.
BANKS	10	83	31	61	2214	20754	669	423	0.66	46.
BANKS	1	84	31	0	1639	20372	657	468	0.65	47.
CLIFTON	1	84	31	0	2932	18551	598	889	0.59	52.
BANKS	4	83	30	0	2219	7270	242	534	0.23	129.
CLIFTON	4	83	30	0	2267	6689	223	619	0.21	140.

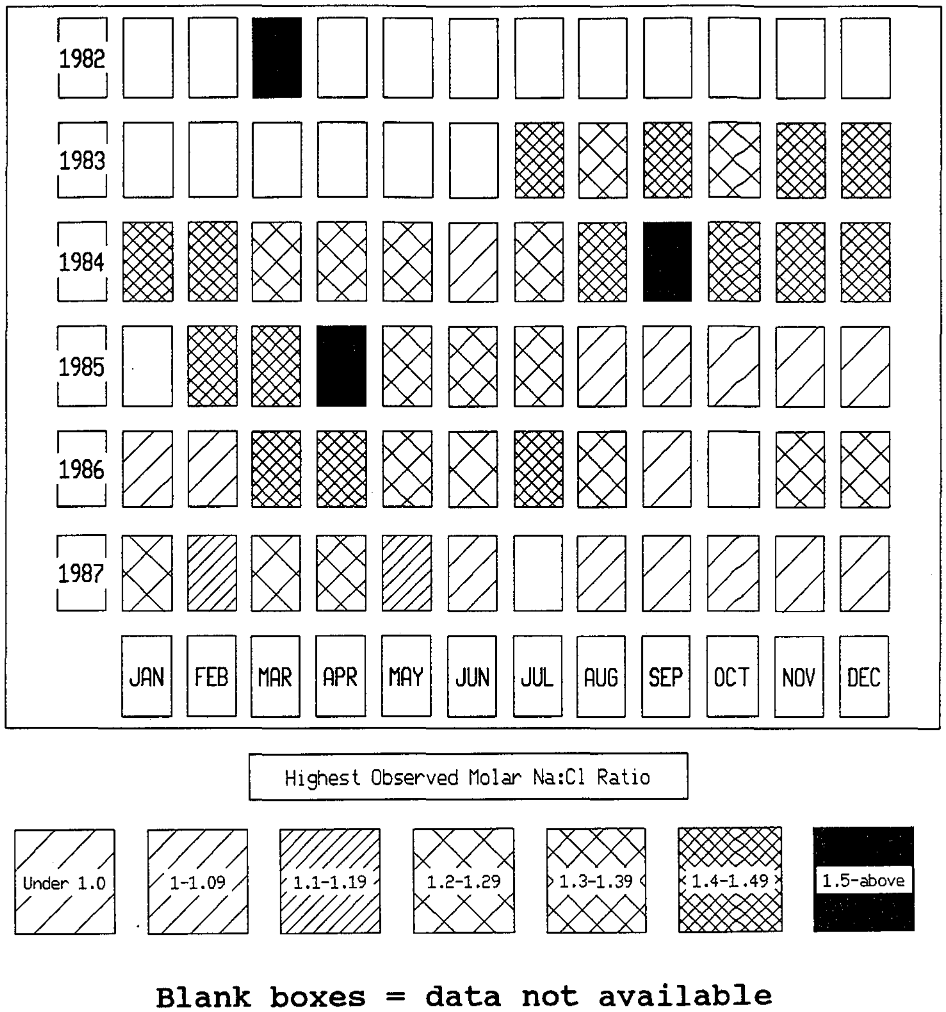


Figure B-1
MONTHLY MOLAR SODIUM TO CHLORIDE ION RATIOS, BANKS PUMPING PLANT HEADWORKS

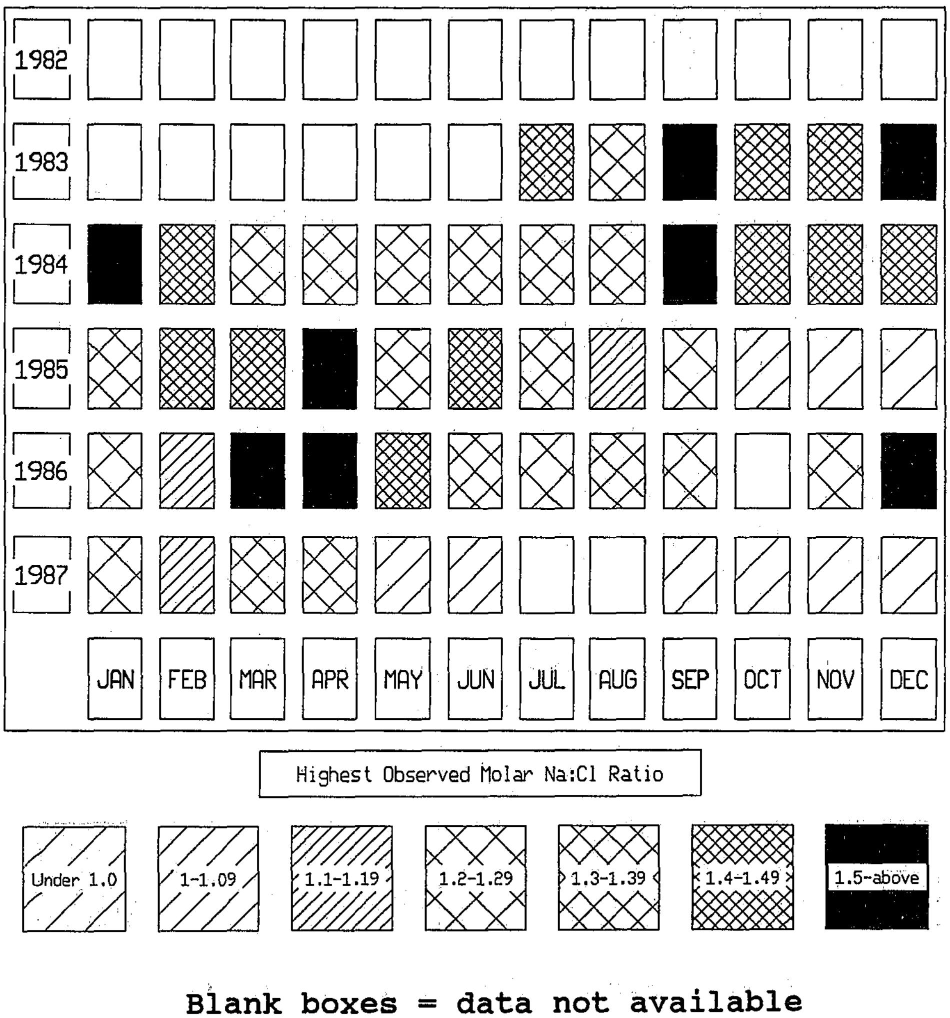


Figure B-2
MONTHLY MOLAR SODIUM TO CHLORIDE ION RATIOS, CLIFTON COURT FOREBAY INTAKE

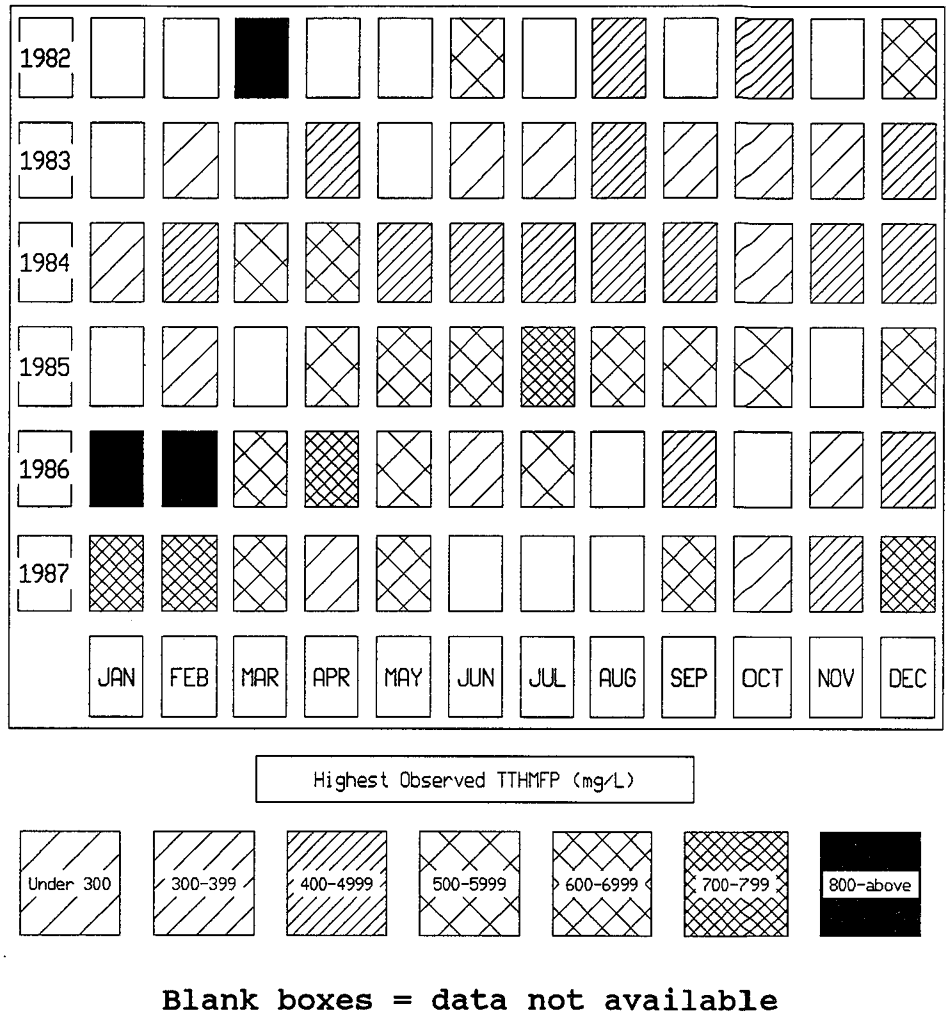


Figure B-3
MONTHLY TOTAL THM FORMATION POTENTIAL CONCENTRATIONS, BANKS PUMPING PLANT HEADWORKS

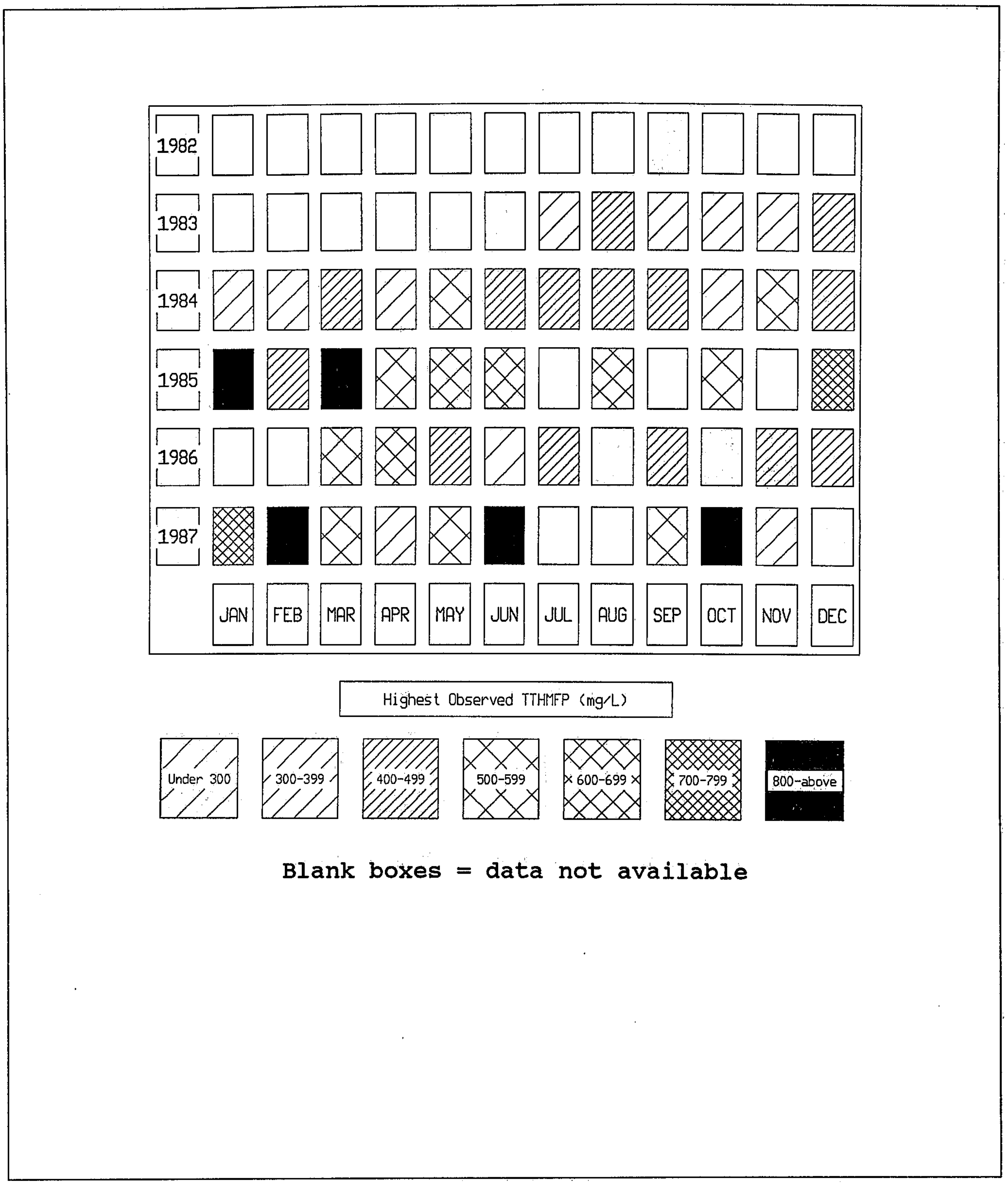


Figure B-4
MONTHLY TOTAL THM FORMATION POTENTIAL CONCENTRATIONS, CLIFTON COURT FOREBAY INTAKE

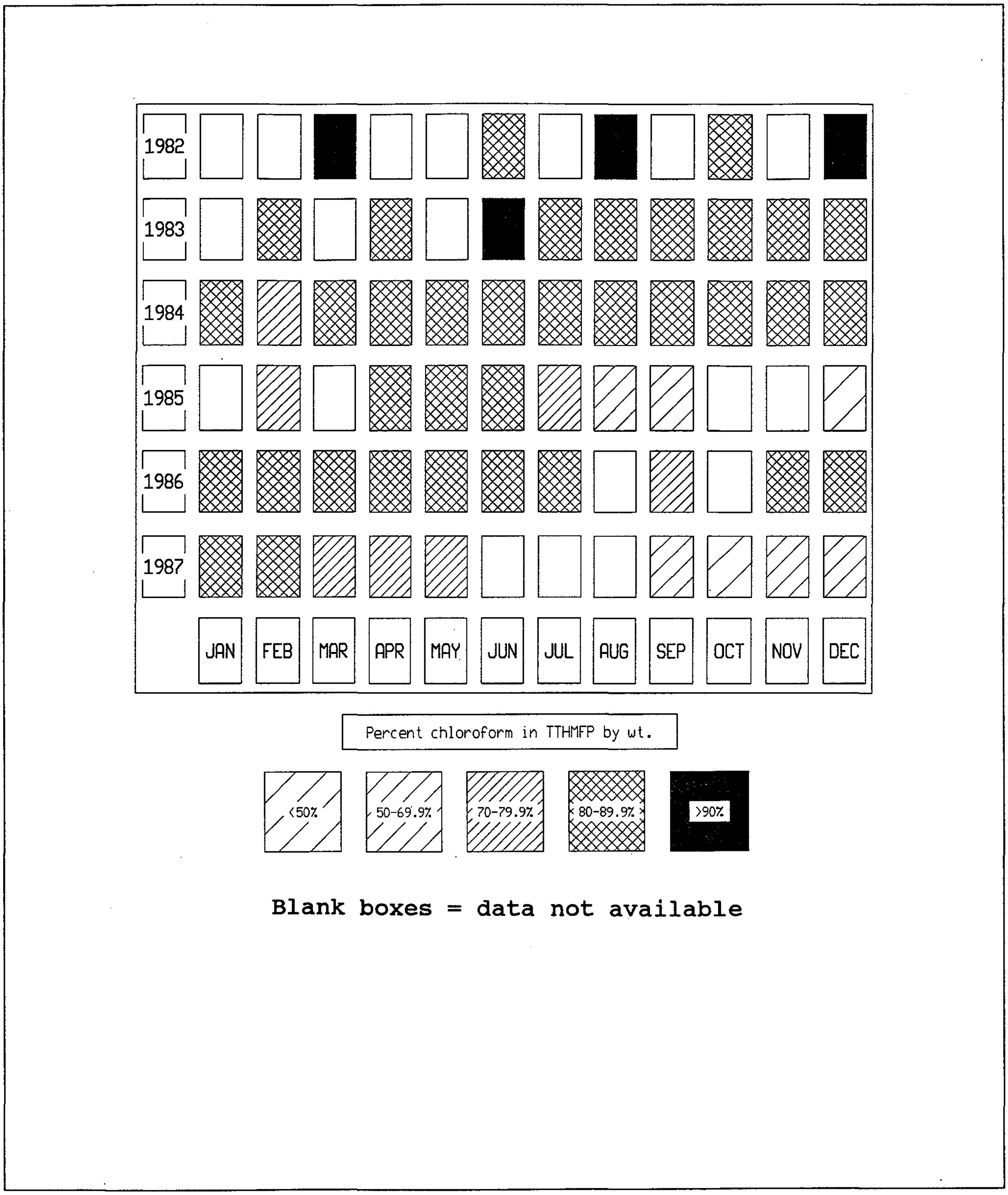


Figure B-5
MONTHLY PERCENTAGE OF CHLOROFORM IN TOTAL THM FORMATION POTENTIAL, BANKS PUMPING PLANT HEADWORKS

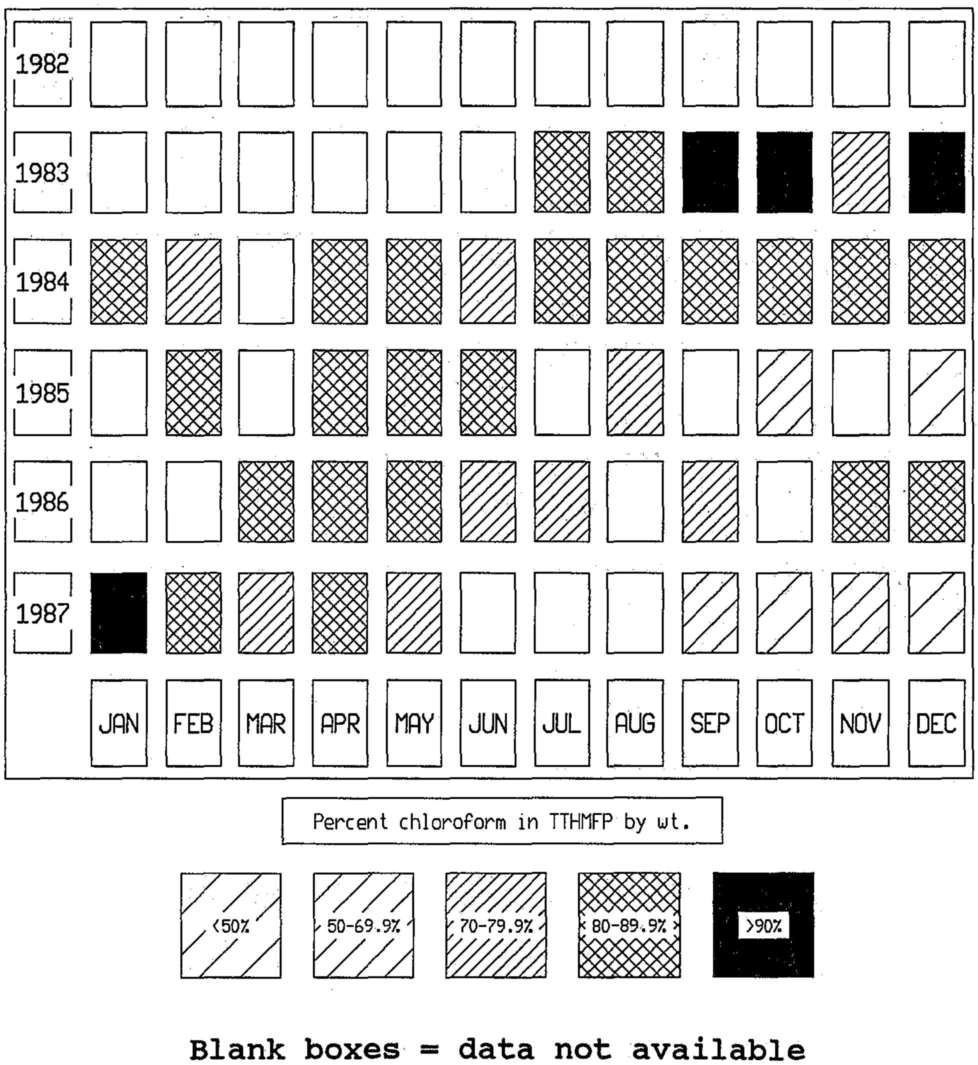


Figure B-6
MONTHLY PERCENTAGE OF CHLOROFORM IN TOTAL THM FORMATION POTENTIAL, CLIFTON COURT FOREBAY INTAKE

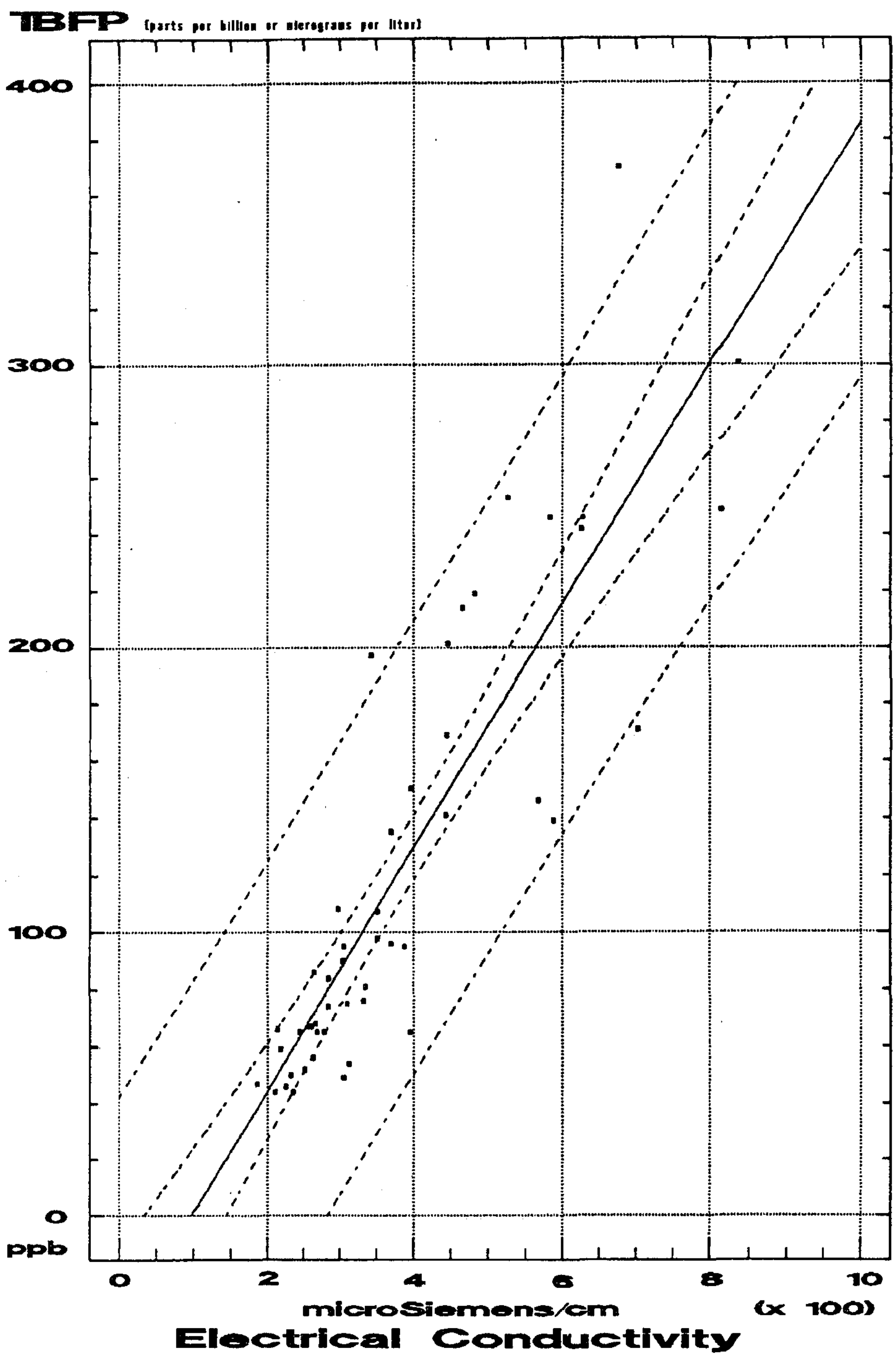


Figure B-7
TOTAL BROMINATED METHANE FORMATION POTENTIAL vs. ELECTRICAL CONDUCTIVITY,
BANKS PUMPING PLANT HEADWORKS

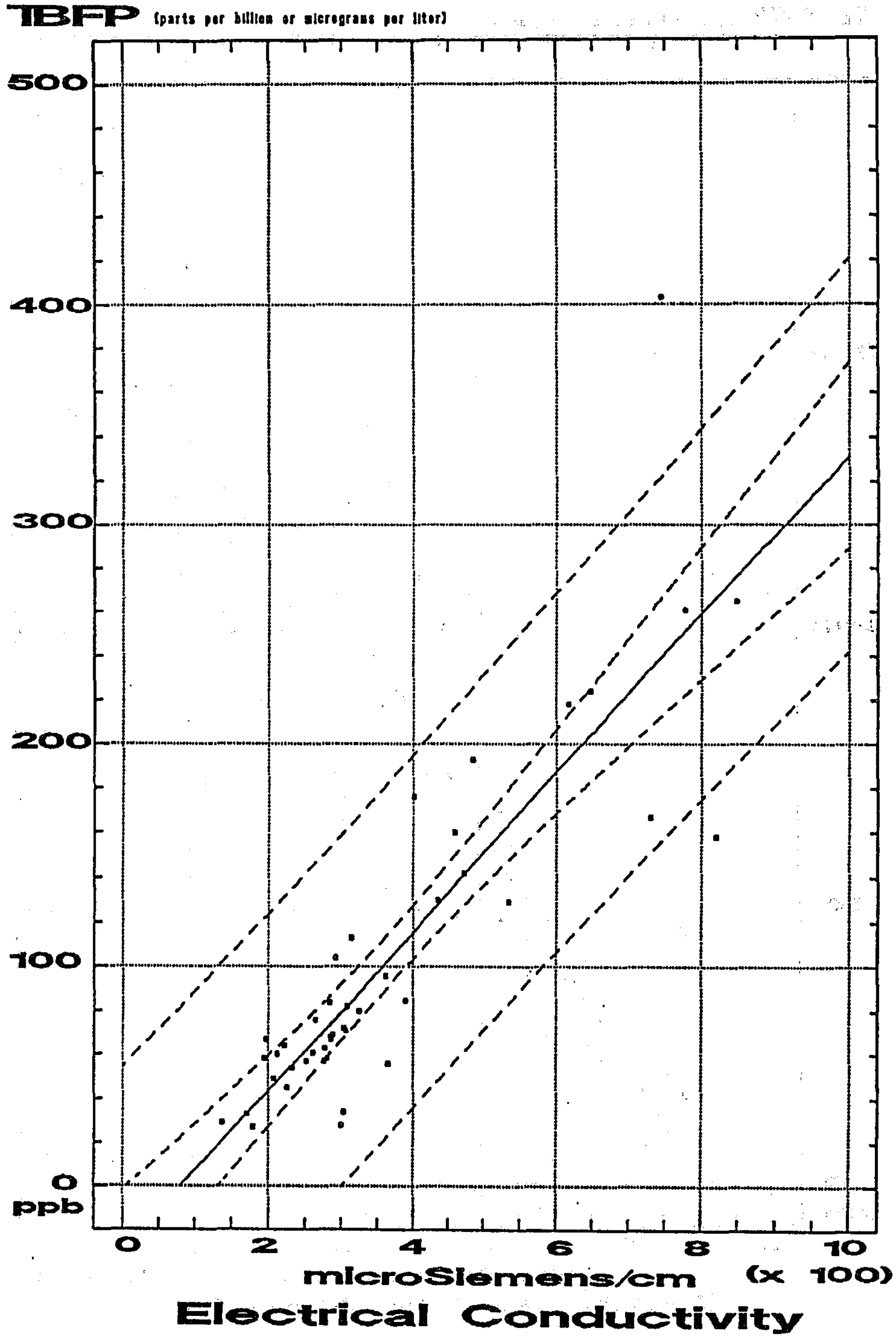


Figure B-8
TOTAL BROMINATED METHANE FORMATION POTENTIAL vs. ELECTRICAL CONDUCTIVITY, CLIFTON COURT FOREBAY INTAKE

Appendix C
PREVIOUS STUDIES

This section gives an overview of the Interagency Delta Health Aspects Monitoring Program and results of previous progress reports.

State Water Project Trihalomethane Study

The Department of Water Resources conducted a study from September 1981 through January 1982 to determine:

» Sources of THM-forming agents (precursors) in the Sacramento-San Joaquin Delta, Sacramento River, and State Water Project, and

» Whether there are operational alternatives for reducing concentrations.

The Department concluded that:

- Quality of the State Water Project would benefit from reduced contact with the Delta, because Delta water has abnormally high concentrations of THM precursors and bromides.

- Various Delta water conveyance alternatives might reduce THM precursor and bromide concentrations in State Water Project water. Reductions would depend on the degree of intermingling of Sacramento River water with sea water and amount of contact with Delta soil and agricultural drainage containing THM precursors. In addition, biological productivity in the Delta estuary might be a source of precursors.

- Treated water from the North Bay Aqueduct will likely meet the drinking water limit for THMs. Most of the water diverted from Cache Slough to the North Bay Aqueduct will be supplied from Miner Slough and will, therefore, be a good quality water similar to that in Miner Slough.

- Agricultural drainage appears to be a significant source of THM precursors. Effluent of waste water treatment plants do not appear to be a major source. Aquatic vegetation was not a significant source of THM precursors at the places and times of sampling.

- Peat soils in Delta channels contain significantly high levels of THM precursors.

The following recommendations were made:

- A routine program of THM monitoring should be implemented. This monitoring should include, as a minimum, sampling the Sacramento River at Hood, the Harvey O. Banks Delta Pumping Plant headworks, the San Joaquin River near Vernalis, the Penitencia Water Treatment Plant at the end of the South Bay Aqueduct, Miner Slough, and Cache Slough.

- This monitoring should also include a survey of THM formation potential in waters of the entire State Water Project. Samples should be analyzed for THM formation potential, and data should be correlated on an ongoing basis with THM analyses from the City of Sacramento, Santa Clara Valley Water District, Contra Costa Water District, City of Vallejo, and Metropolitan Water District of Southern California. This work may enable prediction of finished water THM concentrations based on analyses of raw water.

- The additional monitoring would extend the data base needed to evaluate effects of a Delta conveyance facility on THM formation in waters of the State Water Project south of the Delta. The additional data would also help in evaluating the potential for THM formation in the North Bay Aqueduct.

Scientific Panel Report

In August 1982, the DWR Director appointed a scientific panel to assess health aspects of Sacramento-San Joaquin Delta water for domestic use because of concerns expressed by some agencies about the quality of the raw water supplies from the Delta. In particular, the panel was asked to determine any health hazards that may result from use of surface water taken from the Sacramento River between Sacramento and the Delta or from the Delta itself, particularly at Clifton Court Forebay. Further, the Panel was asked about treatments other than those that are standard that might be used to reduce health hazards and what the cost might be.

The scientific panel examined data provided by the Department of Water Resources and other agencies and concluded that:

- With a few exceptions, treatment plants supplied water from the Delta are meeting current drinking water requirements. Based on present knowledge and within the guidelines of EPA interim primary drinking water regulations, conventional treatment with appropriate operations can produce drinking water that poses no known undue health hazards to the public.

- Areas of uncertainty that must be resolved for a full understanding of public health impacts of drinking water from the sources reviewed include the effects, detection, and treatment of asbestos, sodium, and trihalomethanes in drinking water.

- Trihalomethanes, formed as a result of water supply disinfection, can generally be maintained within the EPA drinking water requirements through appropriate operation of conventional water treatment processes. The potential for trihalomethane formation is greater in water from Clifton Court Forebay and Rock Slough than from the Sacramento River because of greater contamination with organic carbon in the Delta.

- Concentrations of sodium at Rock Slough and Clifton Court Forebay are high enough to cause concern for the health of individuals who must limit their intake of sodium to control hypertension. Concentrations are especially high during certain times of most years and especially during droughts. Concerns are heightened for water treated by a typical home water softener.

- Asbestos periodically occurs in relatively high concentrations in all raw waters evaluated, the source being erosion of minerals naturally present in the drainage basin. Conventional treatment can significantly reduce asbestos concentrations to near the lower limits of detection. Because of large fluctuations in concentrations of the water reviewed and insufficient monitoring data, it cannot be assured that normal treatment will be continuously effective. Due to the lack of definitive data on health hazards presented by ingesting asbestos fibers, the risks posed by this uncertainty in removal cannot be evaluated at this time.

- Considerations of public health, as affected by the quality of drinking water, have not received enough attention in decisions about water management for the Delta, which is the source (though not always the sole source) of drinking water for about 15 million people.

- The Decision 1485 water monitoring program now conducted by the Department of Water Resources was developed primarily to monitor water quality from an ecological perspective specifically directed toward fishery resources, and not to assess human health aspects with respect to drinking water. Although the program provided information for this report, is not entirely adequate to assess the present or projected suitability of the Delta as a source of drinking water.

The panel made the following recommendations in its report:

- Considerations of public health, as affected by the quality of drinking water, should be given a much higher priority in decisions about the Delta. Examples of decisions that can impact the quality of drinking water include:

  » How to transport water through the Delta.

  » How to solve the levee break problem.

  » Where to locate or relocate drinking water supply intakes.

  » What timing and magnitude of exports from the Delta should be used.

  » Setting Delta water quality standards -- in particular, revisions of Decision 1485 by the State Water Resources Control Board.

- There are public health issues of significant concern with respect to use of Delta water as a drinking water supply. Panel members were divided as to the best approach to this issue. Some believed the long-held public health principle of obtaining drinking water from the best available source should be adhered to. Others expressed the opinion that advanced water treatment technologies could provide an adequate measure of protection. All agreed that the public health issues should be more fully considered in future planning by water purveyors and State authorities.

- Data collection and analysis programs and other studies to resolve public health concerns should be actively pursued. A more comprehensive analytical framework needs to be structured for analyzing alternatives to ameliorate future quality problems. Such a framework is also needed to help predict the effect of proposed system modifications on water quality at various intake locations. This framework should provide a quantitative understanding of the system response, with appropriate adjustments for any areas of uncertainty.

- Trihalomethanes are suspected carcinogens; and they may impose some health risk at any concentration. Therefore, water purveyors should attempt to reduce levels to even below the maximum levels specified by EPA interim primary drinking water regulations whenever it is economically feasible and where this will not impose other, perhaps greater, health risks.

- People whose dietary intake of sodium is limited (to control hypertension) should be informed by the water purveyors of the amount of sodium in water they drink if the source is Rock Slough or Clifton Court Forebay, especially if they have a home water softener.

- To determine the degree to which conventional treatment processes are effective in removing asbestos fibers, water purveyors should periodically monitor for asbestos fibers in both raw and treated waters.

- Each domestic water purveyor should prepare to address one or more of the following eventualities:

  » More stringent requirements on the quality of drinking water.

  » Worsening of raw water quality.

  » Increasing demands for additional water.

- The plan should include possible plant modifications and/or optimizations, use of water from a less contaminated source, provision of additional long-term storage, and/or blending.

Lack of both data and time did not allow the scientific panel to analyze in depth the issue of asbestos in the California Aqueduct. However, the data available show clearly that asbestos concentrations are unusually high in water delivered to Southern California via the California Aqueduct. Conventional treatment with reasonable modifications will not reduce concentrations sufficiently to remove health concerns. Because concentrations in the California Aqueduct exceed the ability of conventional treatment plants to effectively remove the particulates, the panel recommended that:

- Methods other than treatment should be reviewed and considered for reducing asbestos concentrations in water delivered by the California Aqueduct.

- Asbestos monitoring in the California Aqueduct should be continued, both above and below Arroyo Pasajero and in finished water derived from this source.

- Effectiveness of the project to dredge asbestos-rich sediment from the California Aqueduct should continue to be monitored.

- Alternative treatment procedures to reduce asbestos concentrations should be evaluated.

First Project Report

From July 1983 through December 1984, water taken from the Sacramento-San Joaquin Delta easily met primary drinking water criteria established to protect the health of consumers. Observations included:

- Sodium concentrations were generally below levels expected to cause health problems for anyone except people on severely restricted sodium diets. For those people, levels may be high, but they normally would use bottled water.

- Asbestos concentrations in waters of the Delta and its tributary streams are highly variable.

- Although a limited number of selenium samples was taken, no data were developed to suggest that selenium constitutes a health threat for consumers of Delta water supplies. Selenium in Delta water supplies was found only at barely detectable levels, no more than one-tenth the established drinking water Maximum Contaminant Level of 10 ug/L.

- Trihalomethane formation potentials of southern Delta water supplies are higher than in waters tributary to the northern Delta due to bromides from seawater.

- Only a few of the 129 priority pollutants were detected in the samples. Concentrations of compounds observed were below levels expected to pose significant risk to consumers.

- Concentrations of pesticides were far below established drinking water limits in all project samples. Sampling during fall 1984 for specific pesticides most used in Delta watersheds indicates that these agents are not entering Delta waterways in significant quantities. Although further monitoring would be required to verify this finding, preliminary indications are that Delta water supplies are not significantly polluted by pesticides, at least during the fall.

- Although little San Joaquin water is taken into the State Water Project because of the manner in which the project is operated, the San Joaquin River has recently been the subject of great concern with regard to its effect on Delta water supplies. Data collected under this and other programs indicate that San Joaquin River water is not higher in pesticide concentrations than that of other streams tributary to the Delta (such as the Sacramento River). Pesticide levels in samples from all streams measured were far below the established drinking water limits.

- Selenium data collected by the Department of Water Resources and by the U.S. Geological Survey strongly demonstrate that the San Joaquin River is not currently a significant source of selenium to Delta water supplies, although the possibility of future impacts cannot be dismissed.

After the first 18 months of monitoring, recommendations were:

- Data collected under the Interagency Delta Health Aspects Monitoring Program should be used to develop a comprehensive analytical framework for evaluating human health aspects of Delta water supplies. The program should be extended an additional 18 months to collect data needed to satisfy the analytical framework.

- Because asbestos concentrations are highly variable, a very large number of samples would have to be collected and analyzed to determine asbestos levels in the Delta and its tributaries with confidence. Also, recent investigations have failed to indicate that waterborne asbestos causes cancer. Due to these considerations and the cost of analyses, reduction in frequency of asbestos monitoring to once each six months at the regular sampling stations in the program is recommended.

- Because of continued concern regarding selenium in Delta water supplies, monthly monitoring for this constituent should continue at the San Joaquin River, Banks Pumping Plant, Delta-Mendota Canal, Sacramento River, and Lindsey Slough monitoring sites.

- Sampling for trihalomethane potential should be reduced from once a month to once every other month at each regular monitoring site during summer and winter. Monthly monitoring should be continued during spring and fall when hydrologic instability occurs. Because sample filtration ordinarily has no significant effect on trihalomethane potential, filtration should be discontinued.

- Monitoring for bromides should be performed to evaluate the effects of these salts on trihalomethane formation potential of Delta water sources. Analysis of the samples should be sufficiently sensitive to detect bromide levels that are significant in trihalomethane formation.

- Monitoring for organic priority pollutants should continue once each six months at the regular sampling locations in the program. Although previous monitoring has shown low levels of these pollutants, continued surveillance-level monitoring will provide assurance that the levels remain low. Further effort should be devoted to developing field techniques for integrating and concentrating samples for organic pollutant analyses; such techniques would increase the degree of confidence in detecting compounds in monitored streams.

- Monitoring for specific pesticides should continue quarterly at each of the regular sampling stations, and typical agricultural drainages into the Delta and its tributaries should be included. To accomplish this monitoring, the most recent available pesticide use data should be analyzed to identify the most used pesticides. The environmental behavior of these agents should be evaluated to determine which of them should receive monitoring priority. Then, priority pesticides should be sampled at times and in places with the greatest likelihood of finding them in the water.

- Previous monitoring has shown that water quality health aspects of the Mokelumne and Cosumnes rivers are excellent. For the sake of economy, stations there should be eliminated from the list of regular sampling locations. Development in these watersheds may negatively affect water quality in the future. Accordingly, the two stations should be resampled in 3 to 5 years to determine whether or not these streams continue to have excellent water quality.

- To the extent program funding permits, more intensive monitoring of the San Joaquin River watershed should be undertaken to determine whether there is significant potential of pollution of Delta water supplies with pesticides and selenium from this source.

Second Project Report

The second project report of the Interagency Delta Health Aspects Monitoring Program, for 1985 through June 1986, was published in December 1986. Observations were:

- Selenium concentrations in the Delta are meeting the 10 ug/L drinking water standard. The highest concentrations have been in the lower San Joaquin River, in Mud and Salt sloughs. Subsequent dilution and natural removal processes result in concentrations of 2 ug/L or less near Vernalis. The data indicate that selenium does not constitute a health threat to consumers of Delta water supplies.

- Pesticide concentrations have been far below Department of Health Services action levels or drinking water criteria. When found, levels were barely above the analytical limit of detection (generally 1 ug/L or less). The data indicate a wide margin of safety in the drinking water quality with respect to harmful pesticide concentrations.

- Irrigation return flow drainage can have major effects on water quality. Preliminary data indicate that drainage from Delta islands is a major contributing source of trihalomethane precursor materials and may have the most significant effect on the total trihalomethane formation potential of Delta water supplies exported by the State and Federal water projects.

- Asbestos analyses of surface waters need to be improved to obtain reproducible results. Until the methodology is refined, asbestos data cannot be interpreted.

- Sodium levels in Delta channels met the National Academy of Sciences recommended limit of 270 mg/L for people on moderately restricted sodium diets. However, levels exceeded the 20 mg/L limit for people on severely restricted sodium diets. (People on severely restricted sodium diets generally drink sodium-free water.)

- Quality of export water was significantly affected by Sacramento River flows and tidal influences during the last half of 1985. Comparisons of chloride and sodium ratios showed the direction and predominant source of water to the export pump intakes. Electrical conductivity measurements alone were insufficient *tracers* of water movement.

- Quality of export water reflected Sacramento River water mixed with saline bay water. The effects of San Joaquin River quality and flows on export water were not detectable.

- Drinking water quality of the Sacramento River downstream of the Sacramento Regional Wastewater Treatment Plant outfall does not appear to be greatly affected by the waste discharge.

- Use of water quality models to study the fate and transport of constituents in surface water and discharges may help predict water quality changes and improve monitoring effectiveness.

The following recommendations were made:

- Efforts should be continued to meet the long-term objectives of the scientific advisory panel that examined human health factors of Delta water supplies beginning in 1982.

- Monitoring possible effects of San Joaquin River flows and quality on export water should continue in view of public concern over selenium, tides, and agricultural drainage constituents.

- The potential effect of Delta island irrigation return waters on Delta water quality should be examined, as preliminary data suggest these drainages are major sources of trihalomethane precursors and may have the most important effect on the total trihalomethane formation potential of Delta water exported by the State and Federal water projects.

- The monitoring program and special tasks should be performed to meet the information requirements of computer water quality models developed to predict effects on water quality from spills, waste discharges, project operations, and streamflow.

- Standard mineral analyses should be included in the monitoring program to improve the characterization of water sources. Ionic ratios proved to be more useful than electrical conductivity measurements alone.

- Asbestos monitoring should be discontinued until the analytical method for quantifying asbestos can provide confidence in the interpretation of results.

Delta Agricultural Drainage Investigation

As a result of total THM formation potential data collected on farm drainages at three Delta islands (Tyler, Grand, and Empire), the Program's Technical Advisory Group recommended to the Department that Delta agricultural drainages be investigated further. The purpose of this study would be to access the impacts of drainages on Delta water quality with respect to THM control at water treatment plants.

Over 260 drains have been identified in the Delta, and the Department of Water Resources has begun sampling at some 50 drains every three months. More drains may be sampled as permission from landowners is received.

The first report from this study is scheduled for publication by mid-1989.

Appendix D
PESTICIDE SELECTION SCHEME

As a part of the Interagency Delta Health Aspects Monitoring Program, surface water was monitored for agricultural chemicals that might be difficult to control using conventional water treatment practices. In general, such chemicals are water soluble and have a low affinity for adsorption onto particulate matter. Consequently, flocculation, settling, and filtration processes are ineffective in removing these dissolved substances. On the other hand, chemicals with sparingly low water solubilities tend to be readily attracted to solid media and can be controlled in a typical treatment facility.

Selection of chemicals and timing for monitoring at a site can be difficult. Broad scans for hundreds of chemicals are expensive (thousands of dollars per sample) and do not produce significantly more information than does taking a sensible and rational approach. The continued practice of limiting analyses to traditionally monitored chemicals such as banned chlorinated pesticides may be even less productive in assessing current water quality conditions.

The Department chose to develop and use a selection scheme based on a combination of quantitative information (such as reported chemical use patterns and properties) and judgmental assessments (such as major activities upstream of a sampling site). A data base of the quantitative information was compiled for the selection process.

The objective of the scheme was to develop a list of those chemicals with the highest probability of posing treatment difficulties to public water supplies in the Delta. Chemicals on this list would be monitored.

The selection scheme produced site- and time-specific target lists of chemicals for monitoring. The scheme and data base can also be used in other types of monitoring programs (e.g., ground water, biological contamination surveys) by using different selection criteria values, such as ranges of water solubilities and partition coefficients. Target lists could be developed for the different environmental compartments (sediment, water, biota).

Method

Pesticide and crop pattern data of the State Department of Food and Agriculture were compiled to determine the amount and period of usage. Data were obtained for 1983, the most recent database containing a full year of record at the time of the compilation. Data for pesticide usage were ranked for each county and then combined for watersheds of interest to this program (those encompassing our sampling sites). The chemicals were then ranked by usage for each watershed.

Information was compiled for each chemical on water solubility, log P (octanol/water partition coefficients), log Koc (soil activity coefficients), estimated half-life in water, period of use by month, type of use, and whether it was on the AB-1803 list (the California Assembly Bill 1803 list of chemicals that must be monitored in ground water by the Department of Health Services).

The octanol/water partition coefficient is defined as the ratio of a chemical's concentration in the octanol phase to that in the aqueous phase of a 2-phase octanol/water system. The ratios are often reported in logarithmic units (log P). Values of P are meaningful, since they represent the tendency of a chemical to partition itself between an organic phase (e.g., soil, fish) and an aqueous phase. Chemicals with low P values are relatively hydrophilic (water soluble), and have small soil/sediment absorption coefficients and small bioconcentration factors for aquatic life. Chemicals with high P values (log P greater than 4) are very hydrophobic. P values can be measured in the laboratory or estimated from water solubility relationships, knowledge of chemical structure, and other solvent/water partition coefficients.

The soil adsorption coefficient, Koc, is the ratio of the amount of chemical adsorbed per unit weight of organic carbon (oc) in the soil or sediment to that amount in solution at equilibrium. Logarithmic values, log Koc, are reported because of the high range of values. Degree of adsorption affects the chemical's mobility, volatilization, photolysis, hydrolysis, and biodegradation. Koc can be measured in the laboratory and estimated from empirical relationships with other chemical properties (e.g., solubility, log P).

Information on the chemical properties was compiled from recent publications[1] and the *ISHOW* (Information System for Hazardous Organics in the Water Environment) computer database of EPA. When conflicting values were found, the lower values were entered into the database. The degree of error associated with measurements of chemical properties is discussed in Lyman et al.[2]

The chemicals were grouped by selected ranges of reported or calculated water solubilities and specified ranges of partition coefficients as measured by their affinities for water or organic-laden soil (e.g., by log P and log Koc values). Eight groups were created from the following criteria:

Group	Water Solubility	log P and log Koc
1	>999 mg/L	equal to or <2
2	>999 mg/L	>2 but <or equal to 3
3	100-999 mg/L	equal to or <
4	100-999 mg/L	>2 but <or equal to 3
5	10-99 mg/L	equal to or <
6	10-99 mg/L	>2 but <or equal to 3
7	<10 mg/L	equal to or <
8	>10 mg/L	>2 but <or equal to 3

A ninth group that would comprise those chemicals of log P or Koc values above 3 was not pertinent, because it represented the very hydrophobic chemicals generally controllable in a modern water treatment plant.

Chemicals that had certain water solubilities and both log P and log Koc values were sorted and placed into the appropriate groups. However, those chemicals missing solubility data, log P, or Koc data were read as zero values by the computer software program, Lotus Symphony.

The groups represented those chemicals more likely to be dissolved in water (Groups 1 and 2) and those more likely to be in suspended material and organic particles in the water column (increasingly hydrophobic in order of group number).

The selection process for developing a list of candidate chemicals to be monitored consisted of inclusion of the most water soluble chemicals (Group 1 and 2 chemicals) and those with moderate water solubilities and partition coefficients (Groups 3 and 4). Additional pesticides, regardless of solubilities and partition coefficients, were added to the list when applied amounts were significant (among the top in ranked usage for the watershed) and the application method might lead to water contamination. For example, rice herbicides were added to the list because of the large amounts used and because they are applied to rice ponds just a few days before pond water and surface agricultural drainage are discharged into nearby rivers.

To eliminate selection bias, each chemical was given a unique code for identification during the sorting and selection of pesticides for inclusion in the candidate lists. This step was taken to avoid inclusion of chemicals that technically might not meet the selection criteria but that were popular or traditional chemicals in other monitoring studies.

A final target list of chemicals to be monitored at specific stations was developed after data on streamflow direction and upstream pesticide use and cropping patterns were considered. This step reduced the list to those chemicals with the higher probability of contaminating water upstream of the sites. For example, pesticide use data for the watershed where the American River Water Treatment Plant is located

1 Thomson W.T., Agricultural Chemicals Book I, Insecticides. 1982-83 Rev, Thomson Publications, Fresno, CA.
______. Agricultural Chemicals Book II, Herbicides. 1983-84 Rev, Thomson Publications, Fresno, CA.
______. Agricultural Chemicals Book III, Fumigants, Growth, Regulators, Repellents, and Rodenticides. 1983 Rev, Thomson Publications, Fresno, CA.
______. Agricultural Chemicals Book IV, Fungicides. 1982-83 Rev, Thomson Publications, Fresno, CA.
Weed Science Society of America, Herbicide Handbook. 3rd Ed 1974, Champaign, IL.
______. Herbicide Handbook. 4th Ed 1979, Champaign, IL.
Page, B.G. and W.T. Thomson, The Insecticide, Herbicide, Fungicide Quick Guide 1981. Thomson Publications, Fresno, CA.
U.S. Environmental Protection Agency, Recognition and Management of Pesticide Poison, 2nd Ed, EPA-540/9-77-013, 1977.
Verschueren, K. Handbook of Environmental Data on Organic Chemicals. 2nd Ed, Van Nostrand Reinhold Co., New York, 1983.
The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals, 10th Ed, Merck and Co., New Jersey, 1983.
Cornacchia, J.W. et al, Rice Herbicides: Molinate and Thiobencarb, Spec. Proj. Rpt. 84-4sp, State Water Resources Control Board, 1984.

2 Lyman, W.J. et al, Handbook of Chemical Property Estimation Methods -- Environmental Behavior of Organic Compounds, McGraw-Hill, 1982.

represented use data for Sacramento, El Dorado, and Placer counties. The rice chemicals molinate and thiobencarb ranked high in use and were on the list of candidate chemicals for monitoring. However, rice fields are not located upstream of this site; therefore, these two chemicals were not on the final target list of chemicals to be monitored at the American River Water Treatment Plant site.

Site- and time-specific target lists were developed, since information on months of application (based on cropping patterns) was included in the database. The monthly target lists provided information on which water soluble chemicals would more likely be detected in water in the dissolved phase at the Delta sampling stations.

Conclusion

The data base will be revised as new information on pesticide use, application, and physical/chemical properties is received. Success in developing target lists depends on the reliability and accuracy of such data. The resulting tabulations and information can also be used to predict which chemicals would be found in different compartments of an aquatic system.

The described protocol demonstrates the need to combine numerical selection criteria (usage, solubilities, and partition values) and non-numerical information (station location and upstream activities) to improve the possibility of detecting chemicals in the aquatic system.

Appendix E
SAMPLING, ANALYSIS, AND QUALITY ASSURANCE/CONTROL PROCEDURES

This appendix describes sampling apparatus, sampling and analytical methods, and laboratory performance employed in the Interagency Delta Health Aspects Monitoring Program. Field samples were collected by the Department of Water Resources Central District, Water Quality and Reuse staff. Field measurements included water temperature, pH, dissolved oxygen, and electrical conductivity. Laboratory analyses were conducted by DWR Bryte Laboratory, Clayton Environmental Consultants, and California Analytical Laboratory, Enseco, Inc. (hereafter referred to as Enseco, Inc.). Laboratory analyses included total trihalomethane formation potential, pesticides and other organic compounds, total organic carbon, sodium, chloride, selenium, color, turbidity, metals, and asbestos.

Sampling Apparatus

Since mid-1987, samples have been collected in a specially designed stainless steel bucket developed by DWR. The sample bucket was equipped with one valve and handle; it can contain up to 2 gallons of water. The 1-foot height of the bucket allows easy access to shallow water without contact with sediment. Teflon packings in the valve system eliminate contamination with oil from conventional packing materials. The valve can be easily regulated to control drip-type flows for filling small volatile organic chemical (VOC) analysis vials. The handle is made of stainless steel covered with polyethylene to prevent contamination. Before the bucket is used, it is washed in Alconox (R), rinsed in tap water, air dried, and covered with detergent-washed aluminum foil.

Samples were also collected by a Kemmerer sampler (3-foot stainless steel tube with Teflon closures and a triggering mechanism). As with the current sampling bucket, the tube was washed, rinsed, dried, and wrapped in washed foil to prevent contamination. Use of the tube device was discontinued, because it was too long for some of the shallow agricultural drains and because it was desirable to have valves that could finely regulate water flow into the 40 milliliter VOC vials.

A solid-state Yellow Springs Industry electrical conductivity/temperature meter with digital readout was used to record EC readings (up to 20,000 microSiemens per centimeter) and temperature (in degrees Celsius).

The Hellige colorimetric pH comparator was used to determine pH.

Sampling Methods

Samples for total THM formation potential analyses were filtered through 0.45 Millipore membrane filter, using a stainless steel filtration apparatus that was washed in detergent, rinsed, dried, and wrapped in detergent-washed foil prior to sampling. The purpose of filtration was to eliminate trihalomethane forming materials that might be attached to particles; these would ordinarily be removed in water treatment processes.

Filtration apparently has only a minor effect on THM formation potential of most fresh water samples. Twenty-five fresh water samples were analyzed in duplicate, one sample filtered and the other unfiltered. The average difference between the filtered and unfiltered samples was 14 percent, the unfiltered sample having the higher total THM formation potential; this difference is in the order of magnitude of the analytical variation of the test method. The filtered or unfiltered sample water was poured into 40 mL screw-top VOC vials with Teflon septa, leaving no headspace, as specified by the Environmental Protection Agency.

Water samples for total organic carbon analyses were poured into acid-fixed 30 mL glass bottles with tapered glass stoppers, then sealed with washed foil and transported iced to the DWR Bryte Laboratory. Later in the program, TOC samples were collected in

250 mL glass bottles fitted with Teflon-coated septa and transported to Enseco, Inc.

Dissolved oxygen concentrations were determined in the field by the modified Winkler titration method *(Water Quality Sampling Manual, DWR, 1975).* The modified Winkler titration method involves formation of manganese sulfate, which reacts with potassium iodide causing free iodine to be released. The number of moles of iodine released is equivalent to the number of moles of oxygen in the sample.

Asbestos samples were collected in pint-sized polyethylene bottles, stored in the dark, and shipped on the day of collection via express mail to EMS Laboratories, Inc., in Hawthorne, California. Asbestos sampling was discontinued after the middle of 1986 because of poor precision and high variability in results.

Synthetic organic pollutant samples were collected in gallon containers, (three per sample) for analysis of extractables. Also, 40 mL samples were collected in glass containers (five per sample) for VOC analyses. Sample containers were completely filled, eliminating headspace. Volatilization losses during filling were minimized by tilting sample vials and allowing the sample to run down the inside of the vial without causing turbulence. The caps of the 40 mL sample containers were fitted with Teflon-coated septa, as specified by EPA. Samples were delivered to Clayton Environmental Consultants (prior to July 1987) and to Enseco, Inc. (after July 1987) within 24 hours of collection.

Analytical Methods

The DWR Bryte Laboratory has been responsible for preparing total THM formation potential samples for analysis. Preparation includes inoculation, incubation, and quenching of samples. Raw water samples for total THM formation potential analyses were chlorinated (inoculated) at about 120 milligrams per liter chlorine dosage. This high dosage was used to assure a chlorine residual after the 7-day incubation period at 25 degrees Celsius. At the end of 7 days, the chlorine residual was determined. Samples were then dechlorinated (quenched), using sodium thiosulfate, and analyzed for total THM formation potential by the gas chromatograph purge and trap method established by EPA Method 601.

Until November 1986, Bryte Laboratory conducted the full analysis of samples for total THM formation potential. When installation of new analytical equipment resulted in a backlog of work, total THM formation potential analysis was performed by Clayton Environmental Consultants from November 1986 to 1987. Later, Enseco, Inc., conducted total THM formation potential analyses on samples that had been chlorine-spiked, incubated, and quenched by Bryte Laboratory.

Asbestos samples were analyzed by EMS Laboratories, Inc., conforming to methodology and reporting procedures of EPA Method 600-4-80-005, "Interim Method for Determining Asbestos in Water". The samples were filtered through a Millipore filter and a disc cut out and placed on a carbon-coated electron microscope grid. A transmission electron microscope was used to count a minimum of 100 asbestos fibers per sample or 20 grid squares, enumerating the total number of asbestos fibers as well as only those longer than 5 microns. The transmission electron microscope also allowed full characterization of the type of asbestos present (chrysotile, amphibole, etc.).

Synthetic organic pollutant and pesticide samples were analyzed by Clayton Environmental Consultants and later by Enseco, Inc., using EPA Methods 601 (purgeable halocarbons), 602 (purgeable aromatics), 608 (organochlorine pesticides), 614 (organophosphorus pesticides), 624 (purgeable priority pollutants), 625 (base/neutrals and acids), 630 (dithiocarbamate pesticides), 632 (carbamate and urea pesticides) as shown in Table E-1.

Each of the EPA methods includes values for method detection limits, as well as procedures for laboratory quality control. Procedures were followed according to EPA's "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act" (40 CFR, Part 136, revised January 4, 1985).

Bryte Laboratory performed mineral, trace element, and nutrient analyses following EPA Method 600-4-79-020, "Methods for Chemical Analysis of Water and Wastes" (revised March 1983) and the U.S. Geological Service's *Methods for Determination of Inorganic Substances in Water and Fluvial Sediments* (Techniques of Water Resources Inv. of USGS BK 5, Chap. A1, 1985). Laboratory methods performed at Bryte Laboratory for these constituents are listed in Table E-2. Figures E-1 and E-2 show the atomic absorption spectrophotometers used for trace element and mineral analyses.

Table E-1
ENSECO,INC.
LABORATORY METHODS USED FOR PESTICIDES

EPA METHOD 601
PURGEABLE HALOCARBONS

D-D Mixture
Methyl Bromide

EPA METHOD 602
PURGEABLE AROMATICS

Xylene

EPA METHOD 608
ORGANOCHLORINE PESTICIDES

4,4'-DDD
4,4'-DDE
4,4'-DDT
Alachlor
Aldrin
BHC-A
BHC-B
BHC-C
BHC-D
Captan
Chlordane
Copper Dacthal
Dacthal
Dicofol
Dieldrin
Endosulfan 01
Endosulfan 02
Endosulfan
Endosulfan-A
Endosulfan-B
Endrin
Endrin Aldehyde
Heptachlor
Heptachlor Epoxide
PCB-1216
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Toxaphene

EPA METHOD 614
ORGANOPHOSPHORUS PESTICIDES

Carbofuran
Diazinon
Dichlorvos
Dimethoate
Diphenamid
Disulfoton
Ethion
Guthion
Malathion
Metalaxyl
Methamidophos
Methyl Parathion
Parathion

EPA METHOD 615
CHLORINATED PHENOXYACID HERBICIDES

2,4-D
Dinoseb
MCPA

EPA METHOD 619
TRIAZINE PESTICIDES

Atrazine
Simazine

EPA METHOD 630
DITHIOCARBAMATE PESTICIDES

Dithiocarbamate

EPA METHOD 632
CARBAMATE AND UREA PESTICIDES

Carbaryl
Glyphosate
Methomyl
Propham

COLORIMETRIC METHOD

Diquat
Paraquat

GAS CHROMATOGRAPHIC ECD METHOD

Chloropicrin

GAS CHROMATOGRAPHIC METHOD

Bentazon
Bolero
Ordram

PROPANIL WATER LCS

Propanil

EPA METHOD 415.1
TOTAL ORGANIC CARBON

Test methods described here are the more commonly used. However, over the last 5 years, some pesticide constituents have been tested by more than one method.

Table E-2
DWR BRYTE LABORATORY METHODS FOR METALS, MINERALS, NUTRIENTS, AND MISCELLANEOUS

METALS

Aluminum, Atomic Absorption, Direct	EPA	202.1
Aluminum, Atomic Absorption, Furnace, Zeeman	EPA	202.2
Arsenic, Atomic Absorption, Hydride	EPA	206.3
Barium, Atomic Absorption, Direct	EPA	208.1
Cadmium, Atomic Absorption, Furnace, Zeeman	EPA	213.2
Chromium, Atomic Absorption, Furnace, Zeeman	EPA	218.2
Chromium VI, Atomic Absorption, Furnace, Zeeman	EPA	218.5
Cobalt, Atomic Absorption, Furnace, Zeeman	EPA	219.2
Copper, Atomic Absorption, Direct	EPA	220.1
Copper, Atomic Absorption, Furnace, Zeeman	EPA	220.2
Iron, Atomic Absorption, Direct	EPA	236.1
Iron, Atomic Absorption, Furnace, Zeeman	EPA	236.2
Lead, Atomic Absorption, Furnace, Zeeman	EPA	239.2
Lithium, Atomic Absorption, Direct	USGS	I-1425-85
Manganese, Atomic Absorption, Direct	EPA	243.1
Manganese, Atomic Absorption, Furnace, Zeeman	EPA	243.2
Mercury, Atomic Absorption, Cold Vapor	EPA	245.1
Molybdenum, Atomic Absorption, Furnace, Zeeman	EPA	246.2
Nickel, Atomic Absorption, Direct	EPA	249.1
Nickel, Atomic Absorption, Furnace, Zeeman	EPA	249.2
Selenium, Atomic Absorption, Hydride	EPA	270.3
Silver, Atomic Absorption, Furnace, Zeeman	EPA	272.2
Strontium, Atomic Absorption, Direct	USGS	I-1800-85
Zinc, Atomic Absorption, Direct	EPA	289.1
Zinc, Atomic Absorption, Furnace, Zeeman	EPA	289.2

MINERALS

Alkalinity, Titrimetric	EPA	310.1
Boron, Colorimetric, Automated, Azomethane	USGS	I-2115-85
Calcium, Atomic Absorption, Flame	EPA	215.1
Chloride, Colorimetric, Automated	EPA	325.2
Dissolved Solids, Gravimetric, 180°C	EPA	160.1
Fluoride, Potentiometric ISE	EPA	340.2
Magnesium, Atomic Absorption,Flame	EPA	242.1
Nitrate, Colorimetric, Automated Cd Reduction	EPA	353.2
pH, Electrometric	EPA	150.1
Potassium, Atomic Absorption, Flame	EPA	258.1
Silica, Colorimetric, Molybdate Blue	USGS	I-1700-85
Sodium, Atomic Absorption,Flame	EPA	273.1
Specific Conductance, Wheatstone Bridge	EPA	120.1
Sulfate, Colorimetric, Automated MTB	EPA	375.2
Turbidity, Nephelometric	EPA	180.1

NUTRIENTS

Ammonia, Colorimetric, Automated Phenate	EPA	350.1
Ammonia + Organic Nitrogen, Colorimetric, Semi-Automated	EPA	351.2
Nitrate, Colorimetric, Automated Cd Reduction	EPA	353.2
Nitrite, Colorimetric, Automated Cd Reduction	EPA	353.2
Nitrate + Nitrite, Colorimetric, Automated Cd Reduction	EPA	353.2
Phosphate, Colorimetric, Automated Ascorbic Acid	EPA	365.1
Phosphorus, Colorimetric, Semi-Automated	EPA	365.4

MISCELLANEOUS

BOD, Incubation 20°C	EPA	405.1
COD Active Sub. Titrimetric, Low-Level	EPA	410.2
Color, True, Colorimetric, Pt-Co	EPA	110.2
Cyanide, Titrimetric, Spectrophotometric	EPA	335.1
Me. Blue Active Sub. Colorimetric	EPA	425.1
Oil & Grease, Gravimetric, Extraction	EPA	413.1
Organic Carbon, Wet Oxidation, IR, Automated	EPA	415.1
Phenols, Spectrophotometric, Distillation	EPA	420.1
Settleable Solids, Volumetric, Imhoff	EPA	160.5
Suspended Solids, Gravimetric, 105°C	EPA	160.2
Tannin & Lignin, Colorimetric		

EPA *Methods for Chemical Analysis of Water and Wastes,* EPA-600/4-79-020, Rev. March 1983.

USGS *Methods for Determination of Inorganic Substances in Water and Fluvial Sediments,* Techniques of Water Resources, Inv of USGS BK 5, Ch Al, 1985.

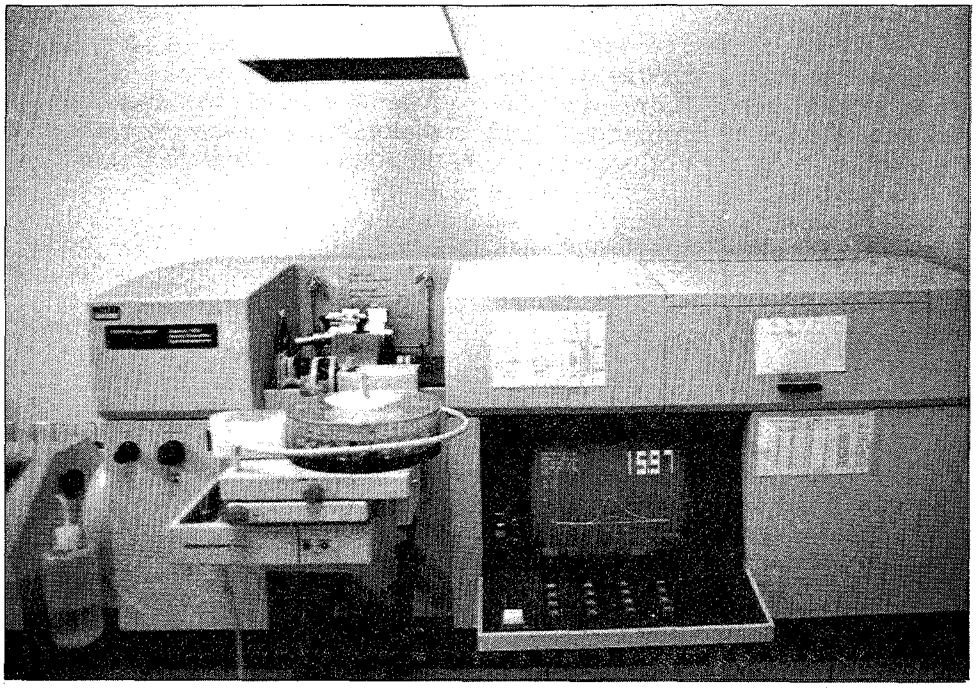


Figure E-1
PERKIN-ELMER ZEEMAN 3030 ATOMIC ABSORPTION SPECTROPHOTOMETER
(For Trace Element and Mineral Analyses)

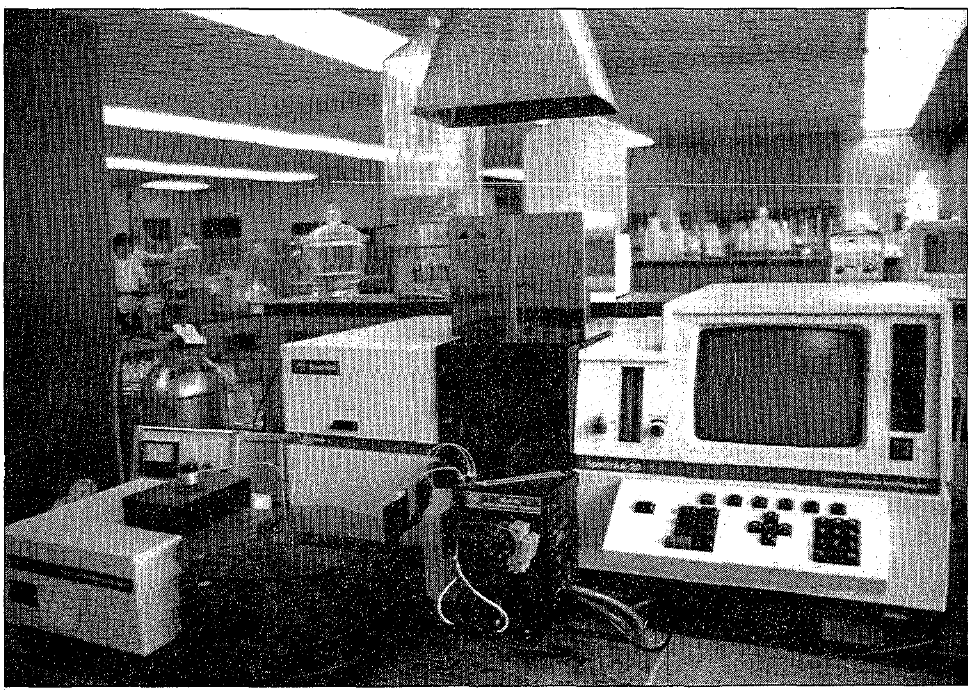


Figure E-2
SPECTR AA20 ATOMIC ABSORBTION SPECTROPHOTOMETER
(For Selenium and Arsenic Analyses)

Laboratory Performance

Performance of all four laboratories used in the 5-year study (DWR's Bryte Laboratory, Clayton Environmental Consultants, EMS Laboratories, Inc., and Enseco, Inc.) was measured by the analytical results of internal quality control and/or inter-laboratory quality assurance samples. Appraisal methods included: analysis of spike samples, field replicates, and laboratory replicates. The Department of Health Services evaluated laboratory analytical quality for total THM formation potential, pesticides, and other organic compounds.

Results of these laboratory performances, or quality assurance/control efforts, are documented in previous progress or project reports of the Interagency Delta Health Aspects Monitoring Program. Following are brief descriptions of each laboratory's quality assurance/control procedures and summaries of the analytical proficiencies.

DWR Bryte Laboratory

The Bryte Laboratory ran laboratory blanks each analytical day. Travel blanks were run along with each group of samples. Standards were run at the beginning and end of each group of analyses. Sample aliquot volumes were adjusted so standards bracketed analyte concentration or were within 10 percent of sample peak height for each compound being analyzed.

Early in the program, Bryte Laboratory had difficulty reporting reproducible TOC results for duplicate samples. The disparity in TOC data was attributed mainly to instrumentation problems. DWR staff later determined that a new TOC analyzer was needed. Contracts were signed with Clayton Environmental Consultants and, later, Enseco, Inc., to perform the TOC analyses until the new instruments at Bryte Laboratory became operational.

Table E-3 shows results of duplicate analyses, demonstrating that the repeatability of Bryte Laboratory analyses is generally quite good. The difference in chloroform values between duplicate samples was considered small and acceptable to the monitoring program. Duplicate samples for EC, sodium, chloride, selenium and turbidity showed excellent reproducibility.

Clayton Environmental Consultants

Clayton Environmental Consultants, a commercial laboratory in Pleasanton, California, was under contract to DWR to provide total THM formation potential, pesticide, and organic pollutant analyses for the program from 1983 to 1987. On occasion, Clayton conducted bromide and dissolved copper analyses when requested. However, these two analyses were discontinued because sample concentrations often were much lower than Clayton laboratory detection limits.

Minimum quality control procedures followed by Clayton Environmental Consultants are:

- One sample was analyzed in duplicate for every ten samples or batch of samples.
- One spiked sample was made for every ten samples or batch of samples. Spikes were made at two to three times the detection limit or at the analyte level.
- Surrogate compounds were used for volatile organic, base/neutral, and acid extractables.
- Method and field blanks were conducted, as appropriate, especially for aqueous samples.

Methods 601, 624 and 625 employed surrogate spike compounds with the analysis of each sample. An internal standard was used with each sample for Method 608, and individual compound recoveries were determined for typical compounds covered by other methods used.

Clayton conducted spike recovery tests on each chemical requested for analysis by DWR. Table E-4 shows results of these tests for field samples collected in June 1985 through May 1986. Both distilled water and field samples were spiked to conduct these recovery measurements.

In general, method spike recoveries varied between sampling runs and among analytes, but recoveries overall were better than 70 percent. Exceptions were analyses for:

» Methamidophos (24 percent, 46 percent, and 60 percent at 40 ug/L);

» 2,4-D salt (50 percent at 20 ug/L);

» MCPA (52 percent at 60 ug/L); and

» Methyl parathion (42 percent at 1 ug/L).

The method spikes represent achievable recovery and variation with the analytical method used by the laboratory. Clayton initiated extraction methods to improve the recovery of methamidophos as a result of the consistently low recoveries.

Table E-3
DWR BRYTE LABORATORY RESULTS OF THM DUPLICATE ANALYSES

THM Duplicate Analyses

											THM Formation Potential					
Station Name	Sampling Date	Temp °C	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	Turb NTU	Col CU	TOC mg/L	$CHCl_3$ ug/L	$CHBrCl_2$ ug/L	$CHBr_2Cl$ ug/L	$CHBr_3$ ug/L	TTHMFP ug/L	Flow cfs
BANKS	09/25/85	22.5	7.5	7.9	69	102	588	6	10	2.7	340	89	40	10	480	3000
BANKS	09/25/85	22.5	7.5	7.9	70	102	584	6	5	6.5	290	170	63	13	540	
VERNALIS	11/15/85	8.5	7.5	9.7	80	94	706	7	15	2.9	220	130	71	7	430	
VERNALIS	11/15/85	8.5	7.5	9.7	80	94	709	7	5	4.1	240	130	71	8	450	
MALLARDIS	12/03/85	12.0	7.5	9.9	1760	3130	9970	8	8	3.4	11	72	340	640	1100	
MALLARDIS	12/03/85	12.0	7.5	9.9	1760	3130	9950	8	5	7.1	9	78	280	540	910	
GREENES	02/27/86	12.5	7.1	10.5	4	2	84	64	20	4.2	340	7	*	*	350	80000
GREENES	02/27/86	12.5	7.1	10.5	4	2	84	63	10	2.9	320	8	*	*	330	
CLIFTON	04/09/86	16.5	7.2	8.8	20	20	197	14	20	3.9	570	62	5	*	640	1500
CLIFTON	04/09/86	16.5	7.2	8.8	20	20	195	14	30	3.9	610	53	5	*	670	1095
CLIFTON	11/05/87	18.0	7.3	7.6	113	190	821	6	*		180	67	78	13	338	
CLIFTON	11/05/87	17.5	7.4	8.3	73	115	616	6	5		240	130	76	12	458	
NOBAY	05/28/86	19.5	8.3	9.6	9	5	306	7	5	3.1	300	15	1	*	320	
NOBAY	05/28/86	19.5	8.3	9.5	10	5	300	6	10	7.3	120	8	3	2	130	
LINDSEY	06/25/86	21.5	8.0	7.2	43	37	461	38	20	22.0	350	36	4	1	390	
LINDSEY	06/25/86	20.0	7.9	7.2	44	38	480	38	10	8.4	270	34	8	3	320	
LITTLECON	07/09/86	23.0	7.7	7.6	10	10	154	9	10	5.0	280	30	1	*	310	
LITTLECON	07/09/86	23.0	7.9	7.6	10	11	153	8	10	6.2	310	67	2	*	380	
ROCKSL	08/14/86	23.5	7.5	8.1	21	26	219	22	20	5.3						
ROCKSL	08/14/86	23.5	7.5	8.1	21	26	220	22	5	5.5						
MIDDLER	11/19/86	14.5	7.4	9.1	20	24	230	9	15	2.4	380	41	6	*	430	
MIDDLER	11/19/86	14.5	7.4	9.1	20	24	241	9	10	2.3	370	40	6	*	420	
LINDSEY	12/03/86	9.5	7.5	9.5	42	43	496	22	25	5.4	6294	*	*	*	6294	
LINDSEY	12/03/86	9.5	7.5	9.5	48	43	498	22	25	5.4	2600	110	5	*	2700	
GREENES	01/13/87	7.5	7.3	11.0	7	7	178	8	5	1.7	200	12	*	*	210	
GREENES	01/13/87	7.5	7.3	11.0	7	7	178	8	5	1.8	220	15	*	*	240	
BANKS	02/24/87	11.5	7.3	10.7	41	55	446	9	20	4.3	630	160	41	*	830	5043
BANKS	02/24/87	11.5	7.3	10.7	39	55	443	9	20	4.3	630	98	43	*	780	
AGDGRAND	03/10/87	13.0	7.1	6.6	54	49	852	76	120	28.0	1300	74	2	3	1400	
AGDGRAND	03/10/87	13.0	7.1	6.6	45	50	853	66	120	28.0	1400	67	2	3	1500	
TYLER PP01	03/30/87	15.5	7.0	7.6	40	77	611	30	25	11.0	1100	170	14	*	1300	
TYLER PP01	03/30/87	15.5	7.0	7.6	7	71	54			11.0	870	150	15	*	1000	
UP JONES02	03/30/87	17.0	7.0	5.4	52	60	507	33	200	27.0	2600	160	10	*	2800	
UP JONES02	03/30/87	17.0	7.0	5.4			7149			28.0	1900	160	10	*	2100	
MOSSDALE04	03/31/87	16.0	7.5	3.0	50	53	519	4	*	1.5	150	68	19	*	240	
MOSSDALE04	03/31/87	16.0	7.5	3.0		71	26			1.6	170	87	19	*	280	
NOBAY	04/09/87	1705.0	8.5	9.8	11	6	322	3	5	2.5	240	32	*	*	270	
NOBAY	04/09/87	1705.0	8.5	9.8	11	6	323	3	*	2.2	210	32	3	*	240	
DMC	05/28/87	18.5	7.5	8.6	39	57	405	17	10	2.5	420	130	34	*	580	1714
DMC	05/28/87	18.5	7.5	8.6	40	57	408	18	10	2.4	370	120	33	*	520	
MIDDLER	06/11/87	23.0	6.9	8.9	38				15	3.0	360	86	23	*	470	
MIDDLER	06/11/87	23.0	6.9	8.9	39				15	2.8	290	82	21	*	390	
PROSP01A	08/13/87	19.4	6.9	4.8	17						680	17	*	*	700	
PROSP01B	08/13/87	19.4	6.9	4.8	17						660	19	*	*	680	
PROSP01C	08/13/87	19.4	6.9	4.8	17						660	17	*	*	680	
PROSP01D	08/13/87	19.4	6.9	4.8	17						690	18	*	*	710	
PROSP01E	08/13/87	19.4	6.9	4.8	17						700	18	*	*	720	
PROSP01	08/13/87	19.4	6.9	4.8	12						640	12	*	*	650	
MIDDLER	09/24/87	21.6	7.3	7.1	59				10	2.7						
MIDDLER	09/24/87	21.6	7.3	7.1	59				15	3.0						
AGDGRAND	10/08/87	16.5	7.3	7.2	20				40							
AGDGRAND	10/08/87	16.5	7.3	7.2	26				40							
MOSSDALE08	10/15/87	14.9	7.1	2.5	104				40							
MOSSDALE08	10/15/87	14.9	7.1	2.5	97				40							

Table E-3 (continued)
DWR BRYTE LABORATORY RESULTS OF THM DUPLICATE ANALYSES

THM Duplicate Analyses

Station Name	Sampling Date	Temp °C	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	Turb NTU	Col CU	TOC mg/L	THM Formation Potential: $CHCl_3$ ug/L	$CHBrCl_2$ ug/L	$CHBr_2Cl$ ug/L	$CHBr_3$ ug/L	TTHMFP ug/L	Flow cfs
MOSSDALE09	10/15/87	14.5	7.3	6.2	105				15							
MOSSDALE09	10/15/87	14.5	7.3	6.2	114				10							
ROCKSL	10/22/87	19.0	7.4	8.3	119					2.6						
ROCKSL	10/22/87	19.0	7.4	8.3	119					2.8						
LCONNECTSL	10/28/87	20.0	7.2	7.4	24					2.9						
LCONNECTSL	10/28/87	20.0	7.2	7.4	21					2.9						
LCONNECTSL	10/28/87	20.0	7.2	7.4						2.9						
LCONNECTSL	10/28/87	20.0	7.2	7.4						2.8						

Mineral Duplicate Analyses

Station Name	Sampling Date	Time	Temp °C	pH	DO	Na	Cl	Se	EC	Hard	Ca	Mg	K	Alk	SO_4	NO_3	B	TDS
LINDSEY	09/03/87	0830	21.2	7.5	6.5	42	36		461									
LINDSEY	09/03/87	0830	21.2	7.5	6.5	41	36		460									
AGDGRAND	10/08/87	0700	17.2	7.1	7.5	20	15		340	109	19	15	1.0	113	12	5.7	0.2	194
AGDGRAND	10/08/87	0630	16.5	7.3	7.2	26	23	*	364	116	20	16	1.9	121	14	2.2	0.2	194
MOSSDALE09	10/15/87	1010	14.1	7.1	5.8	114	139		958	245	52	28	4.0	175	98	8.4	0.4	586
MOSSDALE09	10/15/87	0850	14.5	7.3	6.2	105	138	0.002	971	224	47	26	4.2	158	102	8.1	0.4	566
ROCKSL	10/22/87	0930	19.0	7.4	8.3	119	201		871									
ROCKSL	10/22/87	1000	19.0	7.4	8.2	119	201		872									

NOTES:
* = Not Detected
Missing entries indicate constituent was not measured for analyses.

UNIT ABBREVIATIONS
°C = Degrees centigrade
mg/L = Milligrams per liter
uS/cm = MicroSiemens per centimeter
NTU = Nephelometric Turbidity Units
CU = Color Units
ug/L = Micrograms per liter
cfs = Cubic feet per second

STATION NAMES:
AGDGRAND = Agricultural Drain at Grand Island
BANKS = Banks Pumping Plant Headworks
CLIFTON = Clifton Court Forebay Intake
DMC = Delta-Mendota Canal Intake
GREENES = Sacramento River at Greene's Landing
LCONNECTSL = Little Connection Slough at Empire Tract
LITTLECON = Little Connection Slough at Empire Tract
LINDSEY = Lindsey Slough at Hastings Cut
MALLARDIS = Sacramento River at Mallard Island
MIDDLER = Middle River at Borden Highway
MOSSDALE04 = Mossdale Pumping Plant Number 4
MOSSDALE08 = Mossdale Pumping Plant Number 8
MOSSDALE09 = Mossdale Pumping Plant Number 9
NOBAY = North Bay Interim Pumping Plant Intake
PROSP01(A-E) = Prospect Island Pumping Plant Number 1
ROCKSL = Rock Slough at Old River
TYLER PP01 = Tyler Island Pumping Plant Number 1
UP JONES02 = Upper Jones Tract Pumping Plant Number 1
VERNALIS = San Joaquin River near Vernalis

CONSTITUENT NAMES:
Alk = Alkalinity
B = Boron
Ca = Calcium
$CHBr_2Cl$ = Dibromochloromethane
$CHBr_3$ = Tribromomethane (Bromoform)
$CHBrCl_2$ = Dichlorobromomethane
$CHCl_3$ = Trichloromethane (Chloroform)
Cl = Chloride
Col = Color
DO = Dissolved Oxygen
EC = Electrical Conductivity
FLOW = Flow
Hard = Hardness
K = Potassium
Mg = Magnesium
Na = Sodium
NO_3 = Nitrate
pH = pH(Hydrogen Ion Concentration)
Se = Selenium
SO_4 = Sulfate
TDS = Total Dissolved Solids
Temp = Temperature
THM = Trihalomethanes
TOC = Total Organic Carbon
TTHMFP = Total Trihalomethane Formation Potential
TURB = Turbidity

Table E-4
CLAYTON ENVIRONMENTAL CONSULTANTS
RECOVERIES OF SPIKED SAMPLES FOR
IN-HOUSE QUALITY CONTROL MEASUREMENTS

		June 1985		July 1985		August 1985		December 1985		May 1986	
Lab Method	Chemical	Spiked Amount	Percent Recovery	Spiked Amount	Percent Recovery	Spiked Amount	Percent Recovery	Spiked Amount	Percent Recovery	Spiked Amount	Percent Recovery
622	2,4-D Salt	10	71	10	50	10.4	72	20	32	20	50*
HPLC	Bentazon	20	107*	20	93*	30	38	30	75	30	140*
614	Carbofuran	10	110	10	97	5	58	5.3	107*	---	---
GC-ECD	Chloropicrin	11	100	11	27	1.4	62	1.1	73	1.0	120*
608	Dacthal	10	137	10	140	1	100	1	110*	1.5	150*
601/602	D-D Mixture	12	97*	8	101*	20	95	20	88	20	76
622	MCPA	30	74	30	60	31	80	60	42	60	52*
614	Metalaxyl	30	81*	30	81*	5	80	5	54	---	---
614	Methamidophos	315	10	315	10	40	46*	40	60*	40	26*
614	Methyl Bromide	12	98*	8	105*	20	145	20	93	20	119
614	Methyl Parathion	1	42*	10	40	5	100*	5	120*	---	---
614	Molinate	10	119	10	140	5	74*	5.1	82*	---	---
WetChem	Paraquat Dichloride	200	85*	20	77	20	98	20	99	20	75*
614	Thiobencarb	10	110	10	98	5	44	5	94*	---	---
601/602	Xylene	12	98*	8	114*	60	127	40	93	20	74
AAS	Copper	50	106*	50	96	15	111	10	107	---	---
	Bromide	8	91	8	88	0.8	81	---	---	---	---

Values designated by an asterisk (*) designate recoveries of spikes in distilled water samples.
Values without an asterisk (*) in Percent Recovery column were recoveries of spikes to actual field samples.
All units are in ug/L except for bromide, which is in mg/L.

Table E-5
ASBESTOS TRIPLICATES
(CHRYSOTILE TYPE)
October 4 through 18, 1983

Location	Date	MFL
Honker Bay	10/4/83	100
		140
		340
Mokelumne River	10/4/83	9.2
		7.9
		35
Sacramento River at Greene's Landing	10/4/83	260
		520
		350
Cosumnes River	10/4/83	100
		270
		48
San Joaquin River at Vernalis	10/12/83	650
		760
		930
Clifton Court Forebay	10/12/83	760
		400
		440
Banks Pumping Plant	10/12/83	730
		1,400
		460
Delta-Mendota Pumping Plant	10/12/83	670
		640
		960
Rock Slough	10/12/83	620
		1,500
		730
Mallard Slough	10/18/83	780
		510
		770
Del Valle Stream Outlet	10/18/83	59
		54
		50
North Bay Interim Pumping Plant	10/18/83	220
		180
		210

MFL = Million Fibers per Liter

EMS Laboratories, Inc.

EMS Laboratories, Inc., in Hawthorne, California, performed the asbestos analysis early in the program (1983-1984). Blanks followed all steps in preparation and enumeration and were counted daily. When duplicate sample enumerations of total asbestos fibers disagreed by more than 50 percent, samples were rerun.

Table E-5 shows results of triplicate analyses of asbestos samples taken from various locations throughout the Delta. The variability in data results, which were about 1-2 orders of magnitude, were considered too high to continue asbestos sampling. EPA's method provides wide confidence limits (95 percent plus or minus 20 percent), which presents serious limitations to interpreting the data.

Enseco, Inc.

In mid-1987, DWR contracted with Enseco, Inc., to provide total THM formation potential, TOC, pesticide, and priority pollutant analyses for the program. Enseco's Quality Assurance Plan has been developed according to criteria described in EPA's *The Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans.*

As a participant in the EPA Contract Laboratory Program and other contracts including DWR, Enseco, Inc. analyzes blind samples for organic pollutants. In addition, Enseco routinely analyzes internal check samples as described below:

- The frequency of quality control checks (duplicates, spikes and blanks) is equal to at least 10 percent of the total number of samples analyzed. In other words, a pair of laboratory control samples is performed for every 20 samples, and two method blanks are performed for either every 20 samples or one for each batch of samples analyzed, whichever is more frequent.

- Duplicates and spikes are also performed on sample matrices. Surrogates and internal standards are added to each individual sample when applicable. In addition, quality control data are assessed before data results are approved for client use.

- Samples originally submitted to one laboratory are resubmitted as blind samples to either the same laboratory or to other laboratories for comparison. Quality control data are assessed before data results are approved.

Enseco, Inc. analyzed pesticide spiked samples in August and September 1987. Results of matrix spikes, performed in duplicate, show average percent recoveries are within acceptable ranges (see Table E-6).

Table E-6
PESTICIDE PRECISION AND ACCURACY DATABASE
DUPLICATE MATRIX SPIKES
(Units in ug/L, or parts per billion)

	Chemical	Spike*	Quantity Found MS 1	MS 2	Average Percent Recovery
Rock Slough					
Sampled 8/18/87	Dithiocarbamate	100	110	80	95
	2,4-D	10	11.4	12.2	118
	DNBP	10	12.1	13	125
Netherlands Pumping Plant 1					
Sampled 8/19/87	Paraquat	100	100	99	99.5
	Diquat	200	220	224	111
	Bentazon	10	11	9.9	105
	Dithiocarbamate	30	24	26	83
Banks Pumping Plant					
Sampled 8/17/87	Alachlor	2	2.5	2.1	115
	Dacthal	0.5	0.52	0.48	100
	Captan	4	4.1	3.9	100
	Dicofol	4	3.7	3.2	88
	Carbofuran	100	125	110	117.5
	Methyl Parathion	20	19	17	90
	Diazinon	20	21	17	05
	Parathion	20	18	16	85
	Molinate	100	105	60	82.5
	Thiobencarb	100	120	100	110
	2,4-D	10	11.6	12.8	122
	DNBP	10	12.2	13.9	131
	Atrazine	2	1.6	2.4	100
	Simazine	2	1.9	2.2	105
	Methomyl	50	38	32	70
	Carbaryl	50	44	37	81
	Propham	50	45	37	82
	Propanil	10	9.2	8.4	88
	Bentazon	2	1.5	1.3	70
Barker Slough					
Sampled 9/17/87	Dithiocarbamate	30	29.7	24.2	90
Sampled 10/20/87	Bentazon	10	12.3	11.9	121
	Paraquat	200	197	198	99
	Diquat	400	424	425	106
	2,4-D	5	5.7	6	118
	DNBP	5	6.6	6.1	128
	Methomyl	50	45	46	91
	Carbaryl	50	51	53	104
	Propham	50	44	47	91
Mossdale PP #10, Rock Slough					
Sampled 9/16/87	Dithiocarbamate	30	27.9	22.1	83
	Paraquat	200	190	178	92
	Diquat	400	298	408	88
Pierson					
Sampled 9/18/87	Diquat	400	322	376	87
Greene's					
Sampled 9/18/87	Paraquat	200	188	205	98tl

* Matrix Spike Performed in Duplicate - MS 1, MS 2.

Department of Health Services

In May 1986, the Department of Health Services was asked to evaluate the performance of pesticide analyses by Clayton Environmental Consultants and the DWR Bryte Laboratory. Water was collected from the Sacramento River at Greene's Landing and spiked with a variety of pesticides. The DHS Sanitation and Radiation Laboratory in Berkeley performed the spiking. Amounts and materials placed into the water samples were unknown to DWR staff and to the laboratories. The monitoring program staff delivered duplicate sets of the spiked samples to Clayton Environmental Consultants and to Bryte Laboratory.

Duplicate samples from three Delta locations were also submitted to both Clayton and Bryte Laboratories. These samples were not spiked. Both laboratories were requested to analyze for specific compounds and report unidentified peaks in the chromatograms.

The reports of Clayton and Bryte Laboratories were submitted to DHS for review. The initial review suggested there may be significant reporting discrepancies in analyses for some compounds in the spiked reference samples and raised some points that needed clarification (see Attachment 1).

On October 3, 1986, representatives of DHS, DWR, and Clayton met to discuss and clarify the results. The meeting revealed a misunderstanding between Clayton and DWR on the reporting requirements and Clayton's reporting policy on trace contaminants and limits of detection by the laboratory. These discussions are described in Attachment 2. In summary, the qualitative assessment of the Quality Assurance study indicated Clayton is capable of detecting the compounds spiked in the samples. Compounds spiked by DHS but not reported by Clayton resulted when analyses or appropriate analytical methodology were not requested by DWR with sufficient specificity.

In September 1987, DHS evaluated the total THM formation potential data generated by an interlaboratory calibration study involving: Enseco, Inc., Clayton Environmental Consultants, Inc., DHS Sanitation and Radiation Laboratory, and East Bay Municipal Utility District. Interlaboratory calibration results are presented in Attachment 3.

It was the opinion of DHS staff that, although bromoform concentrations in the test samples were low, the concentrations present should have been measurable. The data generating and reporting protocols for bromoform have since been corrected. The current detection limit for reporting bromoform data is 0.5 ug/L.

With the exception of the bromoform problem, all participating laboratories appeared to be proficient in performing THM analyses in support of DWR's total THM formation potential test protocols.

Attachment 1

State of California

Department of Health Services

Memorandum

To : Mr. B. J. Archer, Chief
Water Quality and Reuse Section, Central District
Department of Water Resources (DWR)

Date : September 15, 1986

Subject: QA Evaluation of SRL Spike Sample Study with MES and DWR/Bryte

Via: B. R. Tamplin, Ph.D., Chief MGV for
Sanitation and Radiation Laboratory

From : Michael G. Volz, Ph.D. MGV
Environmental Biochemist
Quality Assurance Officer
Sanitation and Radiation Laboratory

Attached find a qualitative summary of analytical results (Table 1) and pertinent information (Table 2) generated by the Sanitation and Radiation Laboratory of the Department of Health Services (SRL), McKesson Environmental Services (MES), and DWR's Bryte Laboratory (DWR/Bryte) in support of the recent QA activity involving spikes of selected organic chemicals by SRL into river water supplied by DWR.

SRL attempted to meet as many as possible of DWR's requests for spiked samples pertaining to specific analytical groups in this study. However, as indicated in Table 2, we were limited by the breadth of our supply of stock reference samples and chronic problems with instrumentation requisite to substantiate spiked sample composition. Despite these inhibitions, the precision over 4 replications of the combined spiking and analytical protocols for many analytes was exceptionally good (Table 2). This suggests that each laboratory received representative spikes.

After an examination of the results, SRL recommends the following:

(1) MES and DWR/Bryte should reevaluate their analytical data in support of the QA activity taking into account the information presented in Tables 1 and 2.

(a) Some spiked compounds originally not reported actually may have been seen on chromatograms but were not correctly identified.

(b) Other compounds not spiked into river water by SRL but reported by one or both of the other laboratories may simply be misidentifications in conjunction with (a) above or, in the case of analytes associated with those analyses not performed by SRL, may be reflective of actual contamination of the river water.

(2) MES and DWR/Bryte should clarify their reporting procedure for laboratory data. We do not know if some spiked compounds were not reported simply because method and/or matrix "blank" concentrations were accounted for internally prior to the data reporting phase. We also do not know if Limits of Detection were <u>nominal</u> such as the MDLs in the EPA 600 series or whether the <u>reported</u> Limits of Detection were actually attained by the laboratories.

(3) MES and DWR/Bryte should consider the impact(s) of knowing what chemicals specifically mentioned by DWR as requiring quantitation in this activity or as part of DWR's regular IDHAMP monitoring program may have influenced data interpretation following generic laboratory methodology. For example, if it was assumed for one or more reasons that certain substances were expected to be present, was it the convention to assume that the peaks found were "close" enough to warrant a "positive" finding in the absence of more substantive confirmatory information?

(4) MES and DWR/Bryte should address how previous information and chromatographic characteristics in their respective data bases characterizing river water quality may have influenced qualitative interpretations of the data generated in this study.

(5) Quantitative assessments regarding relative laboratory performance on specific analytical methodologies should be addressed in future communications.

Please contact us should you need further assistance at 8-571-2201 or (415) 540-2201.

cc: G. W. Fuhs, Dr. sci. nat., DL/DHS
M. Jung, DWR
R. Woodard, DWR
A. del Rosario, SRL/DHS
S. Khalifa, Ph.D., SRL/DHS

Table 1
Qualitative Summary

Analytical Method Chemical Compound	(µg/L) Spiked** by SRL	Presence Reported* SRL	 MES	 DWR/Bryte
EPA 601/602	(0.5-3)			
Methylene chloride	(+)	+		
1,1-Dichloroethylene	(+)	+		
1,1-Dichloroethane	(+)	+	+	
Chloroform	(+)	+	+	+
Carbon Tetrachloride	(+)	+	+	+
1,2-Dichloropropane	(+)	+	+	
Trichloroethylene	(+)	+	+	+
1,1,2-Trichloroethane	(+)	+		
Dibromochloromethane	(+)	+	+	
Tetrachloroethylene	(+)	+	+	+
Chlorobenzene	(+)	+	+	+
2-Chloroethyl vinyl ether	(+)#			
trans-1,2-Dichloroethylene	(+)	+	+	+
1,2-Dichloroethane	(+)	+	+	
1,1,1-Trichloroethane	(+)	+	+	+
Bromodichloromethane	(+)	+		+
trans-1,3-Dichloropropene	(+)	+		
cis-1,3-Dichloropropene	(+)	+		
Benzene	(+)	(N/A)	+	
Bromoform	(+)	+	+	
1,1,2,2-Tetrachloroethane	(+)	+		
Toluene	(+)	(N/A)	+	
Ethylbenzene	(+)	(N/A)	+	
Dichlorobenzene	(-)	(N/A)		+
EPA 608	(0.2-6)			
Dacthal	(+)	+	+	+
Heptachlor	(+)	+		
Heptachlor Epoxide	(+)	+		
Lindane	(+)	+		
DDE	(+)	+		
Endrin	(+)	+		+
DDD	(+)	+		+
DDT	(+)	+		
Methoxychlor	(+)	+		

Analytical Method Chemical Compound	(ug/L) Spiked** by SRL	Presence Reported* SRL	 MES	 DWR/Bryte
EPA 614	(0.6-0.9)			
Diazinon	(+)	+	+	+
Methyl Parathion	(+)	+	+	
Ethyl Parathion	(+)	+	+	
Molinate	(-)		+	
Carbofuran	(-)		+	
Malathion	(-)		+	+
EPA 622	(12-18)			
2,4-D	(+)	+	+	+
EPA 632-HPLC	(5-8)			
Carbaryl	(+)	(N/A)		
Methomyl	(+)	(N/A)		
GC-ECD	(N.S.)			
Chloropicrin	(-)	(N/A)		
Wet Chemistry	(N.S.)			
Paraquat	(-)	(N/A)		
Others	(N.S.)			
Atrazine/Simazine	(-)	(N/A)		+
EDB	(-)	(N/A)	+	+

* - (+) denotes presence of chemical compound was reported; no entry denotes presence of chemical compound was not reported; data is from Summary Tables in memo of 8/14/86 from B. J. Archer (DWR) to Dr. B. R. Tamplin (SRL/DHS).

** - (+) denotes chemical compound spiked into river water; (-) denotes chemical compound was not spiked into river water.

(N/A) - Chemical compound was not analyzed for. See Table 2 for additional information.

\# - Manufacturer cannot guarantee stability of this compound in standard mixture.

N.S. - Not spiked by SRL.

Table 2

SRL Analytical Support Information[a]

Analytical Method	Limits of Detection	Comment(s)
EPA 601	0.5 μg/L (Nominal)*	See *
EPA 602	(N/A)-0.5 μg/L (Nominal)*	Spiked with Benzene, Toluene, Ethylbenzene. See **
EPA 608	0.01-0.20 μg/L	Method Spike Recoveries: 80 - 90 %: Range in precision for each analyte over all analytes: 1.3 - 11.1 %
EPA 614	0.02 - 0.05 μg/L	Method Spike Recoveries: Range in precision for each analyte over all analytes: 1.3 - 3.2 %
EPA 622	0.08 μg/L (2,4-D)#	Method Spike Recovery:81% precision: ± 9.9%
EPA 632-HPLC	N/A	Spiked with Carbaryl and Methomyl. See **.
GC-ECD	N/A	Did not spike with Chloropicrin.
Wet Chemistry	N/A	Did not spike with Paraquat.

a - Analytical results derived from mean of 4 separate analyses (4 spiked bottles of river water.

* - For purposes of reporting as per AB 1803 policy; for EPA 601 instrumental limits of detection (areal integration) range: 0.003 - 0.19 μg/L.

** - Instrument non-operational.

N/A - Analysis not performed by SRL/DHS.

- Analytical method (SRL/DHS) was from Application Scientist Vol. 1 (J. T. Baker) as per S. Khalifa, Ph.D.

State of California

Department of Health Services

Memorandum

To : Mr. B.J. Archer, Chief
Water Quality and Reuse Section
Central District
Dept. of Water Resources (DWR)
P.O. Box 160088
3251 "S" St.
Sacramento, CA 95816

Date : October 8, 1986

Subject: QA Evaluation of MES' Performance on Spiked River Water Samples

Via : B.R. Tamplin, Ph.D., Chief BRT
Sanitation and Radiation Lab

From: M.G. Volz, Ph.D. MGV
Environmental Biochemist
Sanitation and Radiation Lab

On October 3, 1986, in Pleasanton, CA, Rick Woodard and Marvin Jung of your staff and I met with Dr. Warren Steele of DWR's contract laboratory, McKesson Environmental Services (MES). The purpose of the meeting was to discuss results of the recent Quality Assurance (QA) Study designed to evaluate the analytical proficiency of MES when DWR provided them with river water samples which had been previously spiked with selected organic compounds by the Sanitation and Radiation Laboratory (SRL) of the Department of Health Services (DHS). See attached memo of M. Volz to B. Archer, 9/15/86, for details.

Our discussion has revealed that, rather than analytical methodologies being highly suspect as might be concluded from a superficial evaluation of the attached results, the following statements better describe the data.

1. Some compounds like methylene chloride (a widely used organic solvent in extraction protocols) were not reported because of inherent contamination problems with both samples and blanks that are typical of commercial laboratory operations.

2. Certain compounds co-elute with others on chromatograms, e.g., several of the EPA m601 analytes, thus preventing definitive compound identification and subsequent reporting.

3. Many analytes in the EPA m608 scan were apparently detected on chromatograms by MES staff but were not reported except as "unidentified peaks" pursuant to prior agreement with DWR.

4. <u>Additional</u> compounds reported by MES in the EPA m614 methodology may be reflective of the actual presence of these pesticides in unspiked

river water. A similar argument could be made for Atrazine, Simazine, and EDB.

5. A compound like Bentazon (specifically requested as an analyte by DWR) would not have been seen using EPA m632. Hence, MES utilized an alternate procedure. However, the SRL spikes of Carbaryl and Methomyl then were not quantifiable by MES and not reported.

As a result of the above, SRL/DHS recommends the following:

A. Each chemical which was spiked into river water by SRL but was not reported by MES should be evaluated as an individual analyte and be commented upon by MES to DWR.

B. Similarly each chemical reported by MES but not spiked by SRL should be addressed as in (A). Those instances where the actual presence of compounds in unspiked river water may have been expected to occur should be differentiated from those where suspected or confirmed compound misidentification and reporting has taken place. In the future, unspiked river water also should be provided to participating laboratories to help resolve this issue.

C. Careful evaluation of what truly was expected of MES by DWR and DHS with respect to each and every analyte and/or analytical method under consideration should be made. There appeared to be several instances of miscommunication in the QA Study. Resolution of these discrepancies is essential for future program-and cost effective QA activities in support of the IDHAMP.

D. The performance of DWR's Bryte laboratory also should be carefully evaluated using criteria (A)-(C) above. Proficient laboratory support from this source is essential for the IDHAMP.

E. <u>Quantitative</u> assessment of the present QA Study should be made only after the <u>qualitative</u> aspects described above have been resolved. Perhaps <u>any</u> quantitative assessment should be held in abeyance until EBMUD and MWD have entered future QA evaluations. They both indicated such an interest in our September 26, 1986 meeting.

For further information please contact this office at 8-571-2201 or (415) 540-2201.

cc: G.W. Fuhs, Dr. sci. nat.
P.R. Rogers, SEB
J. Crook, Ph.D., SEB
D.P. Spath, Ph.D., SEB
F. Baumann, SCL
A. del Rosario, SRL
S. Khalifa, Ph.D., SRL

State of California | Department of Health Services

Memorandum

To : Mr. Richard Woodard
Water Quality and Reuse Section
Department of Water Resources
Central District
3251 "S" Street
Sacramento, CA 95816

Date : September 18, 1987

Subject: TTHMFP Data

From : Michael G. Volz, Ph.D. MGV
Environmental Biochemist
Sanitation & Radiation Laboratory
Berkeley 8-571-2201

I have evaluated the TTHMFP data generated by the Interlaboratory Calibration Study and presented in your memo of July 21, 1987 to me. In Table 1, I have presented the average values for each THM reported and the TTHMFP data generated by all laboratories participating in the June 8, 1987 (Test 1) and June 22, 1987 (Test 2) round-robin activities. These data suggest the following:

(1) From the grand averages for TTHMFP in both tests, it appears that the FP protocol is satisfactory ($\pm$ 5%) when conducted by either the individual 40 mL vial (Test 1) or the 1 L batch reactor (Test 2) mode. However, in the future, it would be best to utilize the batch reactor so as to eliminate any treatment variability. This should maximize our ability to discern differences in analytical performance of participant laboratories.

(2) Short-term storage of the test water sample at 4^{o}C following filtration through a 0.45 um membrane filter does not seem to alter precision of the TTHMFP test.

(3) The "ND" results reported by Labs 1 and 2 (Test 1) and by Lab 2 (Test 2) for bromoform ($CHBr_3$) deserve comment. It is my opinion that $CHBr_3$ was present at high enough concentration to have been observed and quantitated by each of the participating laboratories. The Detection Limits for Purposes of Data Reporting (DLR) for AB 1803 are 0.5 ug/L for $CHBr_3$. In contrast, the consensus of results for water samples analyzed in the Interlaboratory Calibration Study (Tests 1 and 2) suggests a sample concentration of $CHBr_3$ of close to an order of magnitude higher than the DLR.

While the amount of $CHBr_3$ present in these samples contributes little to the TTHMFP value, its presence can provide valuable information about both water quality characteristics and potential health risks. Further, the fact that "ND" values have been reported for $CHBr_3$ suggest that further information into data generating and reporting protocols should be requested from participating laboratories. For example, SRL analyzed both diluted and undiluted aliquots of the TTHMFP samples and then reported averages. This was necessary because of both the low concentration of and low relative response factor for $CHBr_3$ and the concurrently high concentrations of the other trihalomethanes.

(4) Aside from the problems involving $CHBr_3$ analysis and reporting discussed in (3), all participating laboratories appear proficient performing THM analyses in support of DWR's TTHMFP test protocols.

cc: Dr. Fuhs (DL)
Dr. Tamplin (SRL)
Dr. Spath (PWSB)
Ms. del Rosario (SRL)

Table 1

EVALUATION OF
INTERLABORATORY CALIBRATION RESULTS
TRIHALOMETHANE ANALYSES

ug/L**

Lab No.*	Test Sample Date	$CHCl_3$	$CHBrCl_2$	$CHBr_2Cl$	$CHBr_3$	TTHMFP	Grand Average
1	6/8/87	217	100	48	ND	363	
2	"	240	130	58	ND	430	391
3	"	213	101	61	5.1	380	
*** Range Ratio		(0.89)	(0.77)	(0.79)	N/A	(0.84)	
1	6/22/87	233	103	59	4.6	403	
2	"	200	103	49	ND	353	373
3	"	204	103	57	5.4	370	
4	"	207	100	58	3.7	367	
*** Range Ratio		(0.86)	(0.97)	(0.83)	(0.69)	(0.88)	(0.95)

* 1 - California Analytical Laboratory-Enseco, Inc.
2 - Clayton Environmental Consultants, Inc.
3 - Dept. of Health Services-Sanitation and Radiation Laboratory
4 - East Bay Municipal Utility District

** Averages of three replications per datum; ND-Not Detected

*** Range Ratio - Ratio of lowest average value to highest average value for a given date and analyte; N/A-Not Applicable

Appendix F
DRINKING WATER STANDARDS AND ADVISORIES

Environmental Protection Agency Maximum Contaminant Levels

The federal MCLs, also known as the Primary Drinking Water Regulations, are federally enforceable limits for contaminants in drinking water established under the authority of the federal Safe Drinking Water Act. The MCLs and proposed MCLs take into consideration health effects; best technology, treatment techniques, and availability of analytical detection methods; and costs of achieving the standard. They are set as close as practicable to the health-based Maximum Contaminant Level Goals.

The Safe Drinking Water Act distinguishes between the primary MCLs, which are enforceable, and the secondary MCLs, which are esthetic quality goals but not enforceable. Secondary standards are noted by "#" in Table F-1.

Environmental Protection Agency Maximum Contaminant Level Goals

The MCLGs are strictly health-based goals derived from toxicological data, and they incorporate appropriate factors of safety. As goals, MCLGs are not enforceable. For carcinogens, EPA uses the non-threshold approach (i.e., that there is absolutely no "safe" level) and sets the MCLG to zero. For chemicals identified as possible carcinogens, EPA treats them as non-carcinogens and will propose an MCLG based on a "no observed adverse effect level". MCLGs can be derived assuming a lifetime of exposure for a 70 kilogram adult who consumes 2 liters of water per day or an exposure to a 10 kilogram child consuming 1 liter of water per day.

California Department of Health Services Maximum Contaminant Levels

California has been granted "primacy" by the Federal Government for enforcement of the Safe Drinking Water Act under specified conditions, including adoption of the water quality and monitoring regulations. These regulations are contained in Title 22, California Code of Regulations, and are comparable to the EPA's National Interim Primary Drinking Water Regulations in Title 40, Code of Federal Regulations. Recently, the Department of Health Services proposed a set of State MCLs for adoption. Some of these are more stringent then the existing EPA's, and some have no comparable federal MCLs. State MCLs are legally enforceable and are developed considering health effects and technical and economic feasibility.

The State distinguishes between primary MCLs, which are generally health-based, and secondary MCLs, which are generally based on such considerations as taste and odor, damage to materials and crops, etc. The secondary MCLs appear in Table F-1 noted by "#". Exceedances of these levels are generally not thought to be hazardous to health.

California Department of Health Services Action Levels

The ALs are derived assuming a 70 kilogram adult consumes 2 liters of water per day, but recently some ALs have been based on the EPA assumption of a 10 kilogram child consuming 1 liter of water per day. For carcinogens, the levels are based on an excess lifetime cancer risk of 10^{-6}. For non-carcinogen pesticides, it is assumed that 20 percent of the daily intake is from drinking water and 80 percent from other sources.

National Academy of Science Health Advisories

National Academy of Science health advisories are calculated to reflect the lifetime exposure to a 70 kilogram adult consuming 2 liters of water per day. The advisories are not enforceable drinking water standards.

Proposition 65 Exposure Limits

In consultation with the Department of Health Services, the California Health and Welfare Agency sets limits that regulate exposure to contaminants from all sources (including air, water and food) known to cause cancer or reproductive toxicity. The limits in Table F-1 have been converted into drinking water exposure limits by assuming that a 70 kilogram adult consumes 2 liters of water per day and that 20 percent of the exposure is from drinking water.

NOTE: Appropriate reference materials should be consulted to determine the applicability of the number being considered.

Table F-1
DRINKING WATER STANDARDS AND CRITERIA

Organic Constituents
(Values in ug/L)

Pesticide	State AL	Proposed State MCL	State MCL	Prop.65 Limit	Proposed Federal MCL	Federal MCL
1,1-Dichloroethane		5				
1,2-Dichloropropane		5				
2,4-D			100		70	
Acrylamide					0***	
Alachlor	0.2**				2	
Aldicarb	10				10	
Aldrin	0.05**			0.004		
Atrazine			3		3	
Bentazon (Basagran)			18			
Bolero (Thiobencarb)			70			
Captan	350					
Carbaryl	60					
Carbofuran		18			40	
Chlordane	0.1	0.1		0.05	2	
Chloropicrin	50 (37*)					
Cis-1,2-Dichloroethylene		6				
Dibromochloropropane	1				0.2	
Diazinon	14					
Dieldrin	0.05**			0.004		
Diethylhexylphthalate		4				
Dimethoate	140					
Endrin			0.2			0.2
Ethion	35					
Ethylene Dibromide			0.02		0.05	
Freon 11		150				
Freon 113		1200				
Glyphosphate	700	700				
Heptachlor	0.01			0.02	0.4	
Heptachlor epoxide		0.01			0.2	
Lindane			4		0.2	
Malathion	160					
Methoxychlor			100		400	
Methyl Parathion	30					
Ordram (Molinate)			20			

Table F-1 (continued)
DRINKING WATER STANDARDS AND CRITERIA

Pesticide	State AL	Proposed State MCL	State MCL	Prop.65 Limit	Proposed Federal MCL	Federal MCL
Parathion	30					
PCBs				0.009	0.5	
Simazine			10			
Toxaphene			5		5	
Trans-1,2-Dichloroethylene		10				
Xylenes (All Isomers)			1,750		10,000	

Miscellaneous
(Values in mg/L Unless Otherwise Shown)

Trace Minerals	State AL	Proposed State MCL	State MCL	Prop.65 Limit	Proposed Federal MCL	Federal MCL
Asbestos (Million Fibers per Liter)					7.1	
Color (Color Units)			15#			15#
Chloride			250#			250#
pH (pH Units)						6.5 8.5#
Selenium			0.01		0.05	0.01
Sodium****						
Specific Conductance (uS/cm)			900#			
TDS			500#			500#
Turbidity (NTU)			5#		0.1#***	1-5#

Trihalomethanes (Treated Water Only)
(Values in ug/L)

Trihalomethanes	State AL	Proposed State MCL	State MCL	Prop.65 Limit	Proposed Federal MCL	Federal MCL
CHCL3 (Trichloromethane or Chloroform)			100			100
CHBRCL (Bromodichloromethane)			100			100
CHBR2CL (Chlorodibromomethane)			100			100
CHBR3 (Tribromomethane or Bromoform)			100			100

Table F-1 (continued)
DRINKING WATER STANDARDS AND CRITERIA

NOTES

*	Taste and Odor Threshold
**	Limit of Quantification
***	Maximum Contaminant Level Goal
****	NAS Advisories are 20 mg/L for people on very restricted sodium diets (less than 500 mg/day total sodium intake) and 100 mg/L for people on moderately restricted sodium diets.
#	Secondary MCLs

Appendix G
MONITORING PROGRAM DATA

The following explanations apply to the accompanying data printouts.

Station Names

AGDEMPIRE	Agricultural Drain at Empire Island
AGDGRAND	Agricultural Drain at Grand Island
AGDTYLER	Agricultural Drain at Tyler Island
AMERICAN	American River at Water Treatment Plant
BANKS	Banks Pumping Plant Headworks
BARKER	Barker Slough at Pumping Plant
CACHE	Cache Slough at Vallejo Pumping Plant
CLIFTON	Clifton Court Forebay Intake
DMC	Delta-Mendota Canal Intake
DVSR	Lake Del Valle Stream Release
GREENES	Sacramento River at Greene's Landing
LCONNECTSL	Little Connection Slough at Empire Tract
LINDSEY	Lindsey Slough at Hastings Cut
MALLARD	Mallard Slough at Contra Costa Water District Pumping Plant
MALLARDIS	Sacramento River at Mallard Island
MIDDLER	Middle River at Borden Highway
NATOMAS	Agricultural Drain at Natomas Main Drain
NOBAY	North Bay Interim Pumping Plant Intake
ROCKSL	Rock Slough at Old River
VERNALIS	San Joaquin River at Vernalis

Constituent Names

TEMP	Temperature
pH	pH
DO	Dissolved Oxygen
Na	Sodium
Cl	Chloride
EC	Electrical Conductivity
TURB	Turbidity
COL	Color
TOC	Total Organic Carbon
THM	Trihalomethanes
CHC13	Trichloromethane (Chloroform)
CHBrC12	Dichlorobromomethane
CHBr3	Tribromomethane (Bromoform)
TTHMFP	Total Trihalomethane Formation Potential
FLOW	Flow

Unit Abbreviations

°C	Degrees Centigrade
mg/L	Milligrams per Liter
uS/cm	Microseimens per Centimeter
NTU	Nephelometric Turbidity Units
CU	Color Units
ug/L	Micrograms per Liter
cfs	Cubic Feet per Second

Notes

ND = Not Detected
< = Concentration of analyte is below reporting limit.
Blank lines indicate test was not run.

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
2,4-D	100(SMCL)	0.2	06/13/84				<0.2			<0.2	<0.2
2,4-D	70(FMCLG)	0.1	07/16/85		<0.1		<0.1	<0.1	<0.1	<0.1	0.1
2,4-D	100(FMCL)	0.01	08/20/85		<0.01		<0.01	<0.01	<0.01	<0.01	<0.01
2,4-D		0.01	12/04/85		<0.01				<0.01		
2,4-D		0.5	05/21/86						1.0		
2,4-D		0.5	06/17/86	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D		0.5	07/15/86	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D		0.2	02/18/87		<0.2					<0.2	<0.2
2,4-D		0.2	03/24/87							<0.2	
2,4-D		0.2	05/28/87							<0.2	
2,4-D		0.25	08/18/87							<0.25	<0.25
2,4-D		0.25	08/19/87	<0.25		0.35					
2,4-D		0.25	08/20/87				<0.25	<0.25	0.5		
2,4-D		0.25	09/16/87							<0.25	<0.25
2,4-D		0.25	09/17/87	<0.25	<0.25	<0.25					
2,4-D		0.25	09/18/87				<0.25	<0.25	0.67		
4,4'-DDD		0.011	10/26/83		<0.011		<0.011			<0.011	<0.011
4,4'-DDD		0.005	02/07/84				<0.005			<0.005	<0.005
4,4'-DDD		0.004	06/13/84				<0.004			0.004	<0.004
4,4'-DDD		0.004	09/19/84			<0.004	<0.004			<0.004	<0.004
4,4'-DDE		0.004	10/26/83		<0.004		<0.004			<0.004	<0.004
4,4'-DDE		0.006	02/07/84				<0.006			<0.006	<0.006
4,4'-DDE		0.002	06/13/84				<0.002			0.007	<0.002
4,4'-DDE		0.002	09/19/84			<0.002	<0.002			<0.002	<0.002
4,4'-DDT		0.012	10/26/83		<0.012		<0.012			<0.012	<0.012
4,4'-DDT		0.004	02/07/84				<0.004			<0.004	<0.004
4,4'-DDT		0.006	06/13/84				<0.006			<0.006	<0.006
4,4'-DDT		0.006	09/19/84			<0.006	<0.006			<0.006	<0.006
Alachlor	0.2(SAL)	0.1	08/18/87							<0.1	
Alachlor	0(FMCLG)	0.1	08/19/87	<0.1	<0.1	<0.1					
Alachlor		0.1	08/20/87				<0.1	<0.1	<0.5		
Alachlor		0.1	09/16/87							<0.1	<0.1
Alachlor		0.1	09/17/87	<0.1	<0.1	<0.1					
Alachlor		0.1	09/18/87				<0.1	<0.1	<0.1		
Aldrin		0.004	10/26/83		<0.004		<0.004			<0.004	<0.004
Aldrin		0.003	02/07/84				<0.003			<0.003	<0.003
Aldrin		0.002	06/13/84				<0.002			<0.002	<0.002
Aldrin		0.002	09/19/84			<0.002	<0.002			<0.002	<0.002
Atrazine	15(SAL)	0.1	08/18/87							<0.1	<0.1
Atrazine		0.1	08/19/87	<0.1		<0.1					
Atrazine		0.1	08/20/87				<0.1	<0.1	0.18		
Atrazine		0.1	09/16/87							<0.1	<0.1
Atrazine		0.1	09/17/87	<0.1		<0.1					
Atrazine		0.1	09/18/87				<0.1	<0.1	<0.1		

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
2,4-D	<0.2	<0.2			0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
2,4-D	<0.1		<0.1								
2,4-D	<0.01		<0.01								
2,4-D											
2,4-D											<0.5
2,4-D	<0.5	<0.5									
2,4-D	<0.5	<0.5	<0.5	<0.5							
2,4-D	<0.2	<0.2		<0.2							
2,4-D											
2,4-D											
2,4-D	<0.25	<0.25	<0.25								
2,4-D											
2,4-D											
2,4-D	<0.25	<0.25	<0.25								
2,4-D											
2,4-D											
4,4'-DDD	<0.011	<0.011				<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
4,4'-DDD	<0.005					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
4,4'-DDD	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
4,4'-DDD	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
4,4'-DDE	<0.004	<0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
4,4'-DDE	<0.006					<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
4,4'-DDE	<0.002	0.003			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
4,4'-DDE	<0.002	<0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
4,4'-DDT	<0.012	<0.012				<0.012	<0.012	<0.012	<0.012	<0.012	<0.012
4,4'-DDT	<0.004					<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
4,4'-DDT	<0.006	<0.006			<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
4,4'-DDT	<0.006	<0.006			<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Alachlor	<0.1	<0.1	<0.1								
Alachlor											
Alachlor											
Alachlor	<0.1	<0.1	<0.1								
Alachlor											
Alachlor											
Aldrin	<0.004	<0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Aldrin	<0.003					<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Aldrin	<0.002	<0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Aldrin	<0.002	<0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Atrazine	<0.1	<0.1									
Atrazine											
Atrazine											
Atrazine	<0.1										
Atrazine											
Atrazine											

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
Captan	350(SAL)	0.5	08/18/87							<0.5	
Captan		0.5	08/19/87	<0.5	<0.5	<0.5					
Captan		0.5	08/20/87				<0.5	<0.5	<2.5		
Captan		0.5	09/16/87							<0.5	<0.5
Captan		0.5	09/17/87	<0.5	<0.5	<0.5					
Captan		0.5	09/18/87				<0.5	<0.5	<0.5		
Carbaryl	60(SAL)	2.0	08/18/87							<2.0	<2.0
Carbaryl		2.0	08/19/87	<2.0		<2.0					
Carbaryl		2.0	08/20/87				<2.0	<2.0	<2.0		
Carbaryl		2.0	09/16/87							<2.0	<2.0
Carbaryl		2.0	09/17/87	<2.0		<2.0					
Carbaryl		2.0	09/18/87				<2.0	<2.0	<2.0		
Carbofuran	36(FMCLG)	0.02	02/07/84				<0.02			<0.02	<0.02
Carbofuran		0.040	06/13/84				<0.040			<0.040	<0.040
Carbofuran		0.5	07/16/85		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5
Carbofuran		0.5	08/20/85		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5
Carbofuran		0.1	12/04/85		<0.1				<0.1		
Carbofuran		0.2	05/21/86						<0.2	<0.2	
Carbofuran		0.2	06/17/86	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carbofuran		0.2	07/15/86	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carbofuran		0.5	02/18/87		<0.5					<0.5	<0.5
Carbofuran		0.5	03/24/87							<0.5	
Carbofuran		0.5	05/28/87							0.8	
Carbofuran		0.5	08/18/87							<0.5	<0.5
Carbofuran		0.5	08/19/87	<0.5	<0.5	<0.5					
Carbofuran		0.5	08/20/87				<0.5	<0.5	<0.5		
Carbofuran		0.5	09/16/87							<0.5	<0.5
Carbofuran		0.5	09/17/87	<0.5	<0.5	<0.5					
Carbofuran		0.5	09/18/87				<0.5	<0.5	<0.5		
Chlordane		0.014	10/26/83		<0.014		<0.014			<0.014	<0.014
Chlordane		0.6	02/07/84				<0.6			<0.6	<0.6
Chlordane		0.08	06/13/84				<0.08			<0.08	<0.08
Chlordane		0.08	09/19/84			<0.08	<0.08			<0.08	<0.08
Chloropicrin	50(SAL)	0.1	07/16/85		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloropicrin	37(SAL)	0.1	08/20/85		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloropicrin		0.1	12/04/85		<0.1		<0.1		<0.1	<0.1	<0.1
Chloropicrin		0.1	05/21/86						<0.1	<0.1	
Chloropicrin		0.1	06/17/86	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloropicrin		0.1	07/15/86	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloropicrin		0.01	02/18/87		<0.01					<0.01	<0.01
Chloropicrin		0.01	03/24/87							<0.01	
Chloropicrin		0.01	05/28/87							<0.01	
D-D Mixture		0.1	07/16/85		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
D-D Mixture		0.1	08/20/85		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
D-D Mixture		0.5	12/04/85		<0.5		<0.5		<0.5	<0.5	<0.5
D-D Mixture		0.2	05/21/86						<0.2	<0.2	
D-D Mixture		0.01	07/15/86								

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
Captan	<0.5	<0.5	<0.5								
Captan											
Captan											
Captan	<0.5	<0.5	<0.5								
Captan											
Captan											
Carbaryl	<2.0	<2.0	<2.0								
Carbaryl											
Carbaryl											
Carbaryl	<2.0										
Carbaryl											
Carbaryl											
Carbofuran	<0.02	<0.02				<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Carbofuran	<0.040	<0.040			1.33	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Carbofuran	<0.5		<0.5								
Carbofuran	<0.5		<0.5								
Carbofuran											
Carbofuran											<0.2
Carbofuran	<0.2	<0.2									
Carbofuran	<0.2	<0.2	<0.2	<0.2							
Carbofuran	<0.5	<0.5		<0.5							
Carbofuran											
Carbofuran											
Carbofuran	<0.5	<0.5	<0.5								
Carbofuran											
Carbofuran											
Carbofuran	<0.5	<0.5	<0.5								
Carbofuran											
Carbofuran											
Chlordane	<0.014	<0.014				<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Chlordane	<0.6					<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Chlordane	<0.08	<0.08			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chlordane	<0.08	<0.08			<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chloropicrin	<0.1		<0.1		<0.1						
Chloropicrin	<0.1		<0.1		<0.1						
Chloropicrin											
Chloropicrin											<0.1
Chloropicrin	<0.1	<0.1									
Chloropicrin	<0.1	<0.1	<0.1	<0.1							
Chloropicrin	<0.01	<0.01	<0.01	<0.01							
Chloropicrin											
Chloropicrin											
D-D Mixture	<0.1		<0.1		<0.1						
D-D Mixture	<0.1		<0.1		<0.1						
D-D Mixture											
D-D Mixture											<0.2
D-D Mixture				<0.2							

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
Dacthal		0.01	07/16/85		<0.01		<0.01	<0.01	<0.01	<0.01	<0.01
Dacthal		0.05	08/20/85		<0.05		<0.05	<0.05	<0.05	<0.05	<0.05
Dacthal		0.3	12/04/85		<0.3				<0.3		
Dacthal		0.01	05/21/86						<0.01	<0.01	
Dacthal		0.01	06/17/86	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dacthal		0.01	07/15/86	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dacthal		0.04	02/18/87		<0.04					<0.04	<0.04
Dacthal		0.04	03/24/87							<0.04	
Dacthal		0.04	05/28/87							<0.04	
Dacthal		0.1	08/18/87							<0.1	
Dacthal		0.1	08/19/87	<0.1	<0.1	<0.1					
Dacthal		0.1	08/20/87				<0.1	0.15	<0.5		
Dacthal		0.1	09/16/87							<0.1	<0.1
Dacthal		0.1	09/17/87	<0.1	<0.1	<0.1					
Dacthal		0.1	09/18/87				<0.1	<0.1	<0.1		
Diazinon	14(SAL)	0.001	02/07/84				<0.001			<0.001	<0.001
Diazinon		0.001	06/13/84				<0.001			0.009	0.004
Diazinon		0.1	08/18/87							<0.1	<0.1
Diazinon		0.1	08/19/87	<0.1	<0.1	<0.1					
Diazinon		0.1	08/20/87				<0.1	<0.1	<0.1		
Diazinon		0.1	09/16/87							<0.1	<0.1
Diazinon		0.1	09/17/87	<0.1	<0.1	<0.1					
Diazinon		0.1	09/18/87				<0.1	<0.1	<0.1		
Dichlorovos		0.002	02/07/84				<0.002			<0.002	<0.002
Dichlorovos		0.005	06/13/84				<0.005			<0.005	<0.005
Dicofal		0.1	08/18/87							<0.1	
Dicofal		0.1	08/19/87	<0.1	<0.1	<0.1					
Dicofal		0.1	08/20/87				<0.1	<0.1	<0.5		
Dicofal		0.2	09/16/87							<0.2	<0.2
Dicofal		0.2	09/17/87	<0.2	<0.2	<0.2					
Dicofal		0.2	09/18/87				<0.2	<0.2	<0.2		
Dieldrin	0.05(SAL)	0.002	10/26/83		<0.002		<0.002			<0.002	<0.002
Dieldrin		0.001	02/07/84				<0.001			<0.001	<0.001
Dieldrin		0.002	06/13/84				<0.002			0.005	<0.002
Dieldrin		0.002	09/19/84			<0.002	<0.002			<0.002	<0.002
Dimethoate	140(SAL)	0.003	02/07/84				<0.003			<0.003	<0.003
Dimethoate		0.010	06/13/84				<0.010			0.046	<0.010
Dinoseb		0.25	08/18/87							<0.25	<0.25
Dinoseb		0.25	08/19/87	<0.25		<0.25					
Dinoseb		0.25	08/20/87				<0.25	<0.25	<0.25		
Dinoseb		0.25	09/16/87							<0.25	<0.25
Dinoseb		0.25	09/17/87	<0.25	<0.25	<0.25					
Dinoseb		0.25	09/18/87				<0.25	<0.25	<0.25		
Diphenamid		0.02	02/07/84				<0.02			<0.02	<0.02
Diphenamid		0.050	06/13/84				<0.050			<0.050	<0.050

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
Dacthal	<0.01		<0.01								
Dacthal	<0.05		<0.05								
Dacthal											
Dacthal											<0.01
Dacthal	<0.01	<0.01									
Dacthal	<0.01	<0.01	<0.01	<0.01							
Dacthal	<0.04	<0.04		<0.04							
Dacthal											
Dacthal											
Dacthal	<0.1	<0.1	<0.1								
Dacthal											
Dacthal											
Dacthal	<0.1	<0.1	<0.1								
Dacthal											
Dacthal											
Diazinon	<0.001	0.003				<0.001	<0.001	<0.001	<0.001	0.1	<0.001
Diazinon	0.004	0.003			0.006	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Diazinon	<0.1	<0.1	<0.1								
Diazinon											
Diazinon											
Diazinon	<0.1	<0.1	<0.2								
Diazinon											
Diazinon											
Dichlorovos	<0.002	<0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dichlorovos	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dicofal	<0.1	<0.1	<0.1								
Dicofal											
Dicofal											
Dicofal	<0.2	<0.2	<0.2								
Dicofal											
Dicofal											
Dieldrin	<0.002	<0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dieldrin	<0.001					<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dieldrin	0.003	<0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002
Dieldrin	<0.002	<0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Dimethoate	<0.003	<0.003				<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Dimethoate	<0.010	<0.010			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dinoseb	<0.25	<0.25	<0.25								
Dinoseb											
Dinoseb											
Dinoseb	<0.25	<0.25	<0.25								
Dinoseb											
Dinoseb											
Diphenamid	<0.02	<0.02				<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Diphenamid	<0.050	<0.050			<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
Diquat		40.0	08/18/87							<40.0	<40.0
Diquat		40.0	08/19/87	<40.0	<40.0	<40.0					
Diquat		40.0	08/20/87				<40.0	<40.0	<40.0		
Diquat		40.0	09/16/87							<40.0	<40.0
Diquat		40.0	09/17/87	<40.0		<40.0					
Diquat		40.0	09/18/87					<40.0	<40.0		
Disulfoton		0.001	02/07/84				<0.001			<0.001	<0.001
Disulfoton		0.001	06/13/84				<0.001			<0.001	<0.001
Dithiocarbamate		6.0	08/18/87							<6.0	<6.0
Dithiocarbamate		6.0	08/19/87	<6.0	<6.0	<6.0					
Dithiocarbamate		6.0	08/20/87				<6.0	<6.0	<6.0		
Dithiocarbamate		3.0	09/16/87							<3.0	<3.0
Dithiocarbamate		3.0	09/17/87	<3.0		<3.0					
Dithiocarbamate		3.0	09/18/87					<3.0	<3.0		
Endosulfan 01		0.003	02/07/84				<0.003			<0.003	<0.003
Endosulfan 01		0.003	06/13/84				<0.003			0.004	<0.003
Endosulfan 01		0.003	09/19/84			<0.003	<0.003			<0.003	<0.003
Endosulfan 02		0.004	02/07/84				<0.004			<0.004	<0.004
Endosulfan 02		0.001	06/13/84				<0.001			<0.001	<0.001
Endosulfan 02		0.001	09/19/84			<0.001	<0.001			<0.001	<0.001
Endosulfan Sulfat		0.066	10/26/83		<0.066		<0.066			<0.066	<0.066
Endosulfan sulfat		0.005	02/07/84				<0.005			<0.005	<0.005
Endosulfan Sulfat		0.008	06/13/84				<0.008			0.01	<0.008
Endosulfan Sulfat		0.008	09/19/84			<0.008	<0.008			<0.008	<0.008
Endosulfan-A		0.014	10/26/83		<0.014		<0.014			<0.014	<0.014
Endosulfan-B		0.004	10/26/83		<0.004		<0.004			<0.004	<0.004
Endrin	2(SMCL)	0.006	10/26/83		<0.006		<0.006			<0.006	<0.006
Endrin	2(FMCL)	0.005	02/07/84				<0.005			<0.005	<0.005
Endrin		0.004	06/13/84				<0.004			<0.004	<0.004
Endrin		0.004	09/19/84			<0.004	<0.004			<0.004	<0.004
Endrin Aldehyde		0.023	10/26/83		<0.023		<0.023			<0.023	<0.023
Endrin aldehyde		0.005	02/07/84				<0.005			<0.005	<0.005
Endrin Aldehyde		0.004	06/13/84				<0.004			<0.004	<0.004
Endrin Aldehyde		0.004	09/19/84			<0.004	<0.004			<0.004	<0.004
Ethion	35(SAL)	0.0002	02/07/84				<0.0002			<0.0002	<0.0002
Ethion		0.001	06/13/84				<0.001			<0.001	<0.001

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
Diquat	<40.0	<40.0	<40.0								
Diquat											
Diquat											
Diquat	<40.0										
Diquat											
Diquat											
Disulfoton	<0.001	<0.001				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Disulfoton	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dithiocarbamate	<6.0	<6.0	<6.0								
Dithiocarbamate											
Dithiocarbamate											
Dithiocarbamate	<3.0										
Dithiocarbamate											
Dithiocarbamate											
Endosulfan 01	<0.003					<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Endosulfan 01	<0.003	<0.003			<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Endosulfan 01	<0.003	<0.003			<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Endosulfan 02	<0.004					<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Endosulfan 02	0.002	0.002			0.005	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Endosulfan 02	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Endosulfan Sulfa	<0.066	<0.066				<0.066	<0.066	<0.066	<0.066	<0.066	<0.066
Endosulfan sulfa	<0.005					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Endosulfan Sulfa	<0.008	0.009			<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Endosulfan Sulfa	<0.008	<0.008			<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Endosulfan-A	<0.014	<0.014				<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Endosulfan-B	<0.004	<0.004				<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Endrin	<0.006	<0.006				<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Endrin	<0.005					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Endrin	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Endrin	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Endrin Aldehyde	<0.023	<0.023				<0.023	<0.023	<0.023	<0.023	<0.023	<0.023
Endrin aldehyde	<0.005					<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Endrin Aldehyde	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Endrin Aldehyde	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Ethion	<0.0002	<0.0002				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Ethion	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
Glyphosate	500(SAL)	1.0	08/18/87								
Glyphosate		1.0	08/19/87								
Glyphosate		1.0	08/20/87					<1.0	<2.0		
Glyphosate		1.0	09/16/87								
Glyphosate		1.0	09/17/87								
Glyphosate		1.0	09/18/87				<1.0	<1.0	10.0		
Guthion		0.008	02/07/84				<0.008			<0.008	<0.008
Guthion		0.100	06/13/84				<0.100			<0.100	<0.100
Heptachlor	0.02(SAL)	0.003	10/26/83		<0.003		<0.003			<0.003	<0.003
Heptachlor	0(FMCLG)	0.003	02/07/84				<0.003			<0.003	<0.003
Heptachlor		0.002	06/13/84				<0.002			<0.002	<0.002
Heptachlor		0.002	09/18/84			<0.002	<0.002			<0.002	<0.002
Heptachlor Epoxid		0.083	10/26/83		<0.083		<0.083			<0.083	<0,083
Heptachlor Epoxid		0.003	02/07/84				<0.003			<0.003	<0.003
Heptachlor Epoxid		0.004	06/13/84				<0.004			<0.004	<0.004
Heptachlor Epoxid		0.004	09/19/84			<0.004	<0.004			<0.004	<0.004
Malathion	160(SAL)	0.002	02/07/84				<0.002			<0.002	<0.002
Malathion		0.001	06/13/84				<0.001			<0.001	<0.001
MCPA		1	07/16/85		<1	<1	<1	<1	<1	<1	<1
MCPA		10	08/20/85		<10	<10	<10	<10	<10	<10	<10
MCPA		2	12/04/85		<2				<2		
MCPA		20	05/21/86						<20	<20	
MCPA		20.0	06/17/86	<20	<20	<20	<20	<20	<20	<20	<20
MCPA		20.0	07/15/86	<20	<20	<20	<20	<20	<20	<20	<20
MCPA		30.0	02/18/87		<30					<30	<30
MCPA		30.0	03/24/87							<30.0	
MCPA		30.0	05/28/87							<30.0	
Metalaxyl		1	07/16/85		<1		<1	<1	<1	<1	<1
Metalaxyl		10	08/20/85		<10		<10	<10	<10	<10	<10
Metalaxyl		0.1	12/04/85		<0.1				<0.1		
Metalaxyl		0.05	05/21/86						<0.05	<0.05	
Metalaxyl		0.05	06/17/86	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Metalaxyl		0.05	07/15/86	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Metalaxyl		0.4	02/18/87		<0.4					<0.4	<0.4
Metalaxyl		0.4	03/24/87							<0.4	
Metalaxyl		0.4	05/28/87							<0.4	
Methamidophos		2	07/16/85		<2		<2	<2	<2	<2	<2
Methamidophos		0.5	08/20/85		<0.5		<0.5	<0.5	<0.5	<0.5	<0.5
Methamidophos		5	12/04/85		<5				<5		
Methamidophos		5	05/21/86						<5	<5	
Methamidophos		5	06/17/86	<5	<5	<5	<5	<5	<5	<5	<5
Methamidophos		5	07/15/86	<5	<5	<5	<5	<5	<5	<5	<5
Methamidophos		10	03/24/87							<10.0	
Methamidophos		10	05/28/87							<10.0	

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
Glyphosate			<1.0								
Glyphosate											
Glyphosate											
Glyphosate											
Glyphosate											
Glyphosate											
Guthion	<0.008	0.020				<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Guthion	<0.100	<0.100			<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Heptachlor	<0.003	<0.003				<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Heptachlor	<0.003					<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Heptachlor	<0.002	<0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Heptachlor	<0.002	<0.002			<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Heptachlor Epoxi	<0.083	<0.083				<0.083	<0.083	<0.083	<0.083	<0.083	<0.083
Heptachlor Epoxi	<0.003					<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Heptachlor Epoxi	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Heptachlor Epoxi	<0.004	<0.004			<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Malathion	<0.002	<0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Malathion	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
MCPA	<1		<1		<1						
MCPA	<10		<10		<10						
MCPA											
MCPA											<20
MCPA	<20	<20									
MCPA	<20	<20	<20	<20							
MCPA	<30	<30		<30							
MCPA											
MCPA											
Metalaxyl	<1		<1								
Metalaxyl	<10		<10								
Metalaxyl											
Metalaxyl											<0.05
Metalaxyl	<0.05	<0.05									
Metalaxyl	<0.05	<0.05	<0.05	<0.05							
Metalaxyl	<0.4	<0.4		<0.4							
Metalaxyl											
Metalaxyl											
Methamidophos	<2		<2								
Methamidophos	<0.5		<0.5								
Methamidophos											
Methamidophos											<5
Methamidophos	<5	<5									
Methamidophos	<5	<5	<5	<5							
Methamidophos											
Methamidophos											

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
Methomyl		2.0	08/18/87							<2.0	<2.0
Methomyl		2.0	08/19/87	<2.0		<2.0					
Methomyl		2.0	08/20/87				<2.0	<2.0	<2.0		
Methomyl		2.0	09/16/87							<2.0	<2.0
Methomyl		2.0	09/17/87	<2.0		<2.0					
Methomyl		2.0	09/18/87				<2.0	<2.0	<2.0		
Methyl Bromide		0.5	07/16/85		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Bromide		0.5	08/20/85		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methyl Bromide		0.7	12/04/85		<0.7		<0.7		<0.7	<0.7	<0.7
Methyl Bromide		0.5	05/21/86						<0.5	<0.5	
Methyl Bromide		0.5	07/15/86								
Methyl Parathion	30(SAL)	0.002	02/07/84				<0.002			<0.002	<0.002
Methyl Parathion		0.001	06/13/84				<0.001			<0.001	0.009
Methyl Parathion		2.5	07/16/85		<2.5		<2.5	<2.5	<2.5	2.5	<2.5
Methyl Parathion		2.5	07/16/85		<2.5		<2.5	<2.5	<2.5	2.5	<2.5
Methyl Parathion		1	08/20/85		<1		<1	<1	<1	<1	<1
Methyl Parathion		1	08/20/85		<2.5		<2.5	<2.5	<2.5	<2.5	<2.5
Methyl Parathion		0.01	12/04/85		<0.01				<0.01		
Methyl Parathion		0.005	05/21/86						<0.005	<0.005	
Methyl Parathion		0.005	06/17/86	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Methyl Parathion		0.005	07/15/86	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Methyl Parathion		0.01	02/18/87		<0.01					<0.01	<0.01
Methyl Parathion		0.01	03/24/87							<0.01	
Methyl Parathion		0.01	05/28/87							<0.01	
Methyl Parathion		0.1	08/18/87							<0.1	<0.1
Methyl Parathion		0.1	08/19/87	<0.1	<0.1	<0.1					
Methyl Parathion		0.1	08/20/87				<0.1	<0.1	<0.1		
Methyl Parathion		0.1	09/16/87							<0.1	<0.1
Methyl Parathion		0.1	09/17/87	<0.1	<0.1	<0.1					
Methyl Parathion		0.1	09/18/87				<0.1	<0.1	<0.1		
Ordram	20(SAL)	1	07/16/85		<1	1	<1	<1	<1	<1	<1
Ordram		0.5	08/20/85		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ordram		0.05	12/04/85		<0.05				<0.05		
Ordram		0.05	05/21/86						<0.05	<0.05	
Ordram		0.05	06/17/86	<0.05	0.94	<0.05	0.43	0.40	0.11	<0.05	0.17
Ordram		0.05	07/15/86	<0.05	<0.05	<0.05	<0.05	<0.05	0.3	0.56	1.4
Ordram		0.01	03/24/87							<0.01	
Ordram		0.01	05/28/87							0.08	
Ordram		0.5	08/18/87							<0.5	<0.5
Ordram		0.5	08/19/87	<0.5		<0.5					
Ordram		0.5	08/20/87				<0.5	<0.5	<0.5		
Ordram		0.5	09/16/87							<0.5	<0.5
Ordram		0.5	09/17/87	<0.5	<0.5	<0.5					
Ordram		0.5	09/18/87				<0.5	<0.5	<0.5		
Paraquat		10	07/16/85		<10		<10	<10	<10	<10	<10
Paraquat		10	08/20/85		<10		<10	<10	<10	<10	<10
Paraquat		20	12/04/85		<20				<20		
Paraquat		10	05/21/86						<10	<10	

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
Methomyl	<2.0	<2.0	<2.0								
Methomyl											
Methomyl											
Methomyl	<2.0										
Methomyl											
Methomyl											
Methyl Bromide	<0.5		<0.5		<0.5						
Methyl Bromide	<0.5		<0.5		<0.5						
Methyl Bromide											
Methyl Bromide											<0.5
Methyl Bromide				<0.5							
Methyl Parathion	<0.002	<0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methyl Parathion	0.017	0.021			0.040	<0.001	<0.001	<0.001	<0.001	<0.001	0.017
Methyl Parathion	<2.5		<2.5								
Methyl Parathion	<2.5		<2.5								
Methyl Parathion	<1		<1								
Methyl Parathion	<2.5		<2.5								
Methyl Parathion											
Methyl Parathion											<0.005
Methyl Parathion	<0.005	<0.005									
Methyl Parathion	<0.005	<0.005	<0.005	<0.005							
Methyl Parathion	<0.01	<0.01		<0.01							
Methyl Parathion											
Methyl Parathion											
Methyl Parathion	<0.1	<0.1	<0.1								
Methyl Parathion											
Methyl Parathion											
Methyl Parathion	<0.1	<0.1	<0.1								
Methyl Parathion											
Methyl Parathion											
Ordram	<1		<1		<1						
Ordram	<0.5		<0.5		<0.5						
Ordram											
Ordram											<0.05
Ordram	0.16	0.56									
Ordram	<0.05	1.4	1.1	<0.05							
Ordram											
Ordram											
Ordram	<0.5	<0.5									
Ordram											
Ordram											
Ordram	<0.5	<0.5	<0.5								
Ordram											
Ordram											
Paraquat	<10		<10								
Paraquat	<10		<10								
Paraquat											
Paraquat											<10

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
Paraquat		10.0	06/17/86	<10	<10	<10	<10	<10	<10	<10	<10
Paraquat		10.0	07/15/86	<10	<10	<10	<10	<10	<10	<10	<10
Paraquat		20.0	02/18/87		<20					74	<20
Paraquat		20.0	03/24/87							50.0	
Paraquat		20.0	05/28/87							<20.0	
Paraquat		20.0	08/18/87							<20.0	<20.0
Paraquat		20.0	08/19/87	<20.0	<20.0	<20.0					
Paraquat		20.0	08/20/87				<20.0	<20.0	<20.0		
Paraquat		20.0	09/16/87							<20.0	<20.0
Paraquat		20.0	09/17/87	<20.0	<20.0	<20.0					
Paraquat		20.0	09/18/87				<20.0	<20.0	<20.0		
Parathion	30(SAL)	0.0008	02/07/84				<0.0008			<0.0008	<0.0008
Parathion		0.001	06/13/84				<0.001			0.012	<0.001
Parathion		0.1	08/18/87							<0.1	<0.1
Parathion		0.1	08/19/87	<0.1	<0.1	<0.1					
Parathion		0.1	08/20/87				<0.1	<0.1	<0.1		
Parathion		0.1	09/16/87							<0.1	<0.1
Parathion		0.1	09/17/87	<0.1	<0.1	<0.1					
Parathion		0.1	09/18/87				<0.1	<0.1	<0.1		
PCB-1216	0(FMCLG)	Undeter	10/26/83		ND		ND			ND	ND
PCB-1221		undeter	10/26/83		ND		ND			ND	ND
PCB-1232		undeter	10/26/83		ND		ND			ND	ND
PCB-1242		0.065	10/26/83		<0.065		<0.065			<0.065	<0.065
PCB-1248		Undeter	10/26/83		ND		ND			ND	ND
PCB-1254		Undeter	10/26/83		ND		ND			ND	ND
PCB-1260		Undeter	10/26/83		ND		ND			ND	ND
Propanil		0.5	08/18/87							<0.5	<0.5
Propanil		0.5	08/19/87	<0.5		<0.5					
Propanil		0.5	08/20/87				<0.5	<0.5	<0.5		
Propanil		0.5	09/16/87							<0.5	<0.5
Propanil		0.5	09/17/87	<0.5		<0.5					
Propanil		0.5	09/18/87					<0.5	<0.5		
Propham	350(SAL)	2.0	08/18/87							<2.0	<2.0
Propham		2.0	08/19/87	<2.0		<2.0					
Propham		2.0	08/20/87				<2.0	<2.0	<2.0		
Propham		2.0	09/16/87							<2.0	<2.0
Propham		2.0	09/17/87	<2.0		<2.0					
Propham		2.0	09/18/87				<2.0	<2.0	<2.0		
Simazine	150(SAL)	0.1	08/18/87							<0.1	<0.1
Simazine		0.1	08/19/87	<0.1		<0.1					
Simazine		0.1	08/20/87				<0.1	<0.1	<0.1		

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
Paraquat	<10	<10									
Paraquat	<10	<10	<10	<10							
Paraquat	<20	<20		<20							
Paraquat											
Paraquat											
Paraquat	<20.0	<20.0	<20.0								
Paraquat											
Paraquat											
Paraquat	<20.0	<20.0	<20.0								
Paraquat											
Paraquat											
Parathion	<0.0008	0.002				<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008
Parathion	0.003	0.003			0.035	<0.001	<0.001	<0.001	<0.001	<0.001	0.003
Parathion	<0.1	<0.1	<0.1								
Parathion											
Parathion											
Parathion	<0.1	<0.1	<0.1								
Parathion											
Parathion											
PCB-1216	ND	ND				ND	ND	ND	ND	ND	ND
PCB-1221	ND	ND				ND	ND	ND	ND	ND	ND
PCB-1232	ND	ND				ND	ND	ND	ND	ND	ND
PCB-1242	<0.065	<0.065				<0.065	<0.065	<0.065	<0.065	<0.065	<0.065
PCB-1248	ND	ND				ND	ND	ND	ND	ND	ND
PCB-1254	ND	ND				ND	ND	ND	ND	ND	ND
PCB-1260	ND	ND				ND	ND	ND	ND	ND	ND
Propanil	<0.5	<0.5									
Propanil											
Propanil											
Propanil	<0.5										
Propanil											
Propanil											
Propham	<2.0	<2.0	<2.0								
Propham											
Propham											
Propham	<2.0										
Propham											
Propham											
Simazine	0.21	<0.1									
Simazine											
Simazine											

Table G-1
Pesticide Data

Barker Slough through Banks Pumping Plant
(Units in ug/L)

Chemical	Standards and Criteria*	Detection Limit **	Sampling Date	Barker Slough @ PP	Sac Rv. @ Mallard Island	Lindsey Slough @ Hastings	Sac Rv @ Greenes Landing	Ag Drain @ Grand Island	Ag Drain @ Empire Tract	San Joaquin Vernalis	Banks PP
Simazine		0.1	09/16/87							<0.1	<0.1
Simazine		0.1	09/17/87	<0.1		<0.1					
Simazine		0.1	09/18/87				<0.1	<0.1	<0.1		
Toxaphene	5(SMCL)	0.24	10/26/83		<0.24		<0.24			<0.24	<0.24
Toxaphene	0(FMCLG)	0.3	02/07/84				<0.3			<0.3	<0.3
Toxaphene		0.63	06/13/84				<0.63			<0.63	<0.63
Toxaphene		0.63	09/19/84			<0.63	<0.63			<0.63	<0.63
Xylene	600(SAL)	0.2	07/16/85		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Xylene	440(FMCLG)	0.5	08/20/85		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene		0.4	12/04/85		<0.4		<0.4		<0.4	<0.4	<0.4
Xylene		0.2	05/21/86						<0.2	<0.2	
Xylene		0.2	07/15/86								

Table G-1
Pesticide Data

Delta Mendota Canal through Clifton Court
(Units in ug/L)

Chemical (Continued from left)	Delta Mendota Canal	Rock Slough	Middle River	Ag Drain @ Tyler Island	Cache Slough	Mokelumne River	American River @ WTP	Consumnes River	Honker Cut	North Bay PP	Clifton Court
Simazine	0.36										
Simazine											
Simazine											
Toxaphene	<0.24	<0.24				<0.24	<0.24	<0.24	<0.24	<0.24	<0.24
Toxaphene	<0.3					<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Toxaphene	<0.63	<0.63			<0.63	<0.63	<0.63	<0.63	<0.63	<0.63	<0.63
Toxaphene	<0.63	<0.63			<0.63	<0.63	<0.63	<0.63	<0.63	<0.63	<0.63
Xylene	<0.2		<0.2		<0.2						
Xylene	<0.5		<0.5		<0.5						
Xylene											
Xylene											<0.2
Xylene				<0.2							

ND = Not Detected

* Standards and Criteria

SMCL: State Maximum Contamination Level
FMCLG: Federal Maximum Contamination Level Goal
SAL: State Action Level
FMCL: Federal Maximum Contamination Level

** Raised detection limits are due to matrix interference.

TABLE G-2

MINOR ELEMENTS DATA REPORT

STA. NAME	SAMP.DATE	TIME	TEMP oC	PH	DO mg/L	EC uS/cm	Ba mg/L	Fe mg/L	Cr mg/L	Cu mg/L	Mn mg/L	Zn mg/L	Li mg/L	Ni mg/L
AGDEMPIRE	07/09/86	8:05	20.5	6.9	5.4	283	<1.	0.250	<0.005	0.010	0.180	0.020	<0.05	<0.005
AGDEMPIRE	08/13/86	8:00	20.5	7.1	5.1	281	<1.	0.250	<0.005	0.010	0.120	0.020	<0.05	<0.005
AGDEMPIRE	09/11/86	7:50	20.5	7.3	5.2	2120	<1.	0.180	<0.005	<0.005	0.600	<0.005	<0.05	<0.005
AGDEMPIRE	11/19/86	10:30	16.0	6.3	2.3	808	<1.	0.916	<0.005	0.017	0.464	0.051	<0.05	0.006
AGDEMPIRE	12/10/86	11:30	12.0	6.3	3.0	866	<1.	0.928	<0.005	0.013	0.576	0.052	<0.05	0.006
AGDEMPIRE	01/13/87	11:15	7.5	6.3	1.7	996	<1.	2.410	<0.005	0.007	1.180	0.026	<0.05	<0.005
AGDEMPIRE	02/10/87	10:00	11.5	6.6	3.5	1660	<1.	2.320	<0.005	0.009	1.940	0.038	<0.05	0.008
AGDEMPIRE	03/10/87	10:50	13.5	6.8	3.0	2390	<1.	0.604	<0.005	0.009	0.892	0.032	<0.05	0.010
AGDEMPIRE	04/16/87	8:30	21.5	7.5	7.2	2510	<1.	0.156	<0.005	<0.005	2.200	0.012	<0.05	0.007
AGDEMPIRE	05/27/87	8:30	19.5	6.6	5.3	408		0.568	<0.005	0.014	0.234	0.027	<0.05	<0.005
AGDEMPIRE	06/11/87	9:30	21.0	6.9	6.4	503	<1.	0.174	<0.005	<0.005	0.242	0.013	<0.05	<0.005
AGDEMPIRE	09/24/87	8:15	19.3	7.3	3.6	2960	<1.	0.073	<0.005	<0.005	0.605	0.074	<0.05	<0.005
AGDEMPIRE	10/28/87	9:10	19.0	7.2	2.1	1340	<1.	0.292	<0.005	<0.005	1.420		<0.05	<0.005
AGDEMPIRE	11/24/87	9:30	12.5	7.2	8.1	312	<1.	0.117	<0.005	<0.005	0.216	0.016	<0.05	0.005
AGDEMPIRE	12/16/87	8:45	8.2	6.5	6.2	695	<1.	0.211	<0.005	0.006	0.270	0.032	<0.05	<0.005
AGDGRAND	07/23/86	11:15	22.5	7.1	6.0	210	<1.	0.180	<0.005	0.010	0.080	0.010	<0.05	<0.005
AGDGRAND	08/27/86	11:45	23.5	7.2	7.6	250	<1.	0.230	<0.005	<0.005	0.080	<0.005	<0.05	<0.005
AGDGRAND	09/09/86	11:00	18.5	7.1	3.0	378	<1.	0.460	<0.005	<0.005	0.310	<0.005	<0.05	<0.005
AGDGRAND	11/19/86	7:50	14.5	7.3	5.8	237	<1.	0.186	<0.005	0.007	0.324	0.028	<0.05	<0.005
AGDGRAND	12/10/86	8:00	10.0	7.1	8.1	366	<1.	0.464	<0.005	0.006	0.228	0.030	<0.05	0.008
AGDGRAND	01/13/87	8:05	7.0	7.1	7.9	458	<1.	0.692	<0.005	0.013	0.260	0.036	<0.05	0.006
AGDGRAND	02/10/87	7:30	14.5	7.2	7.4	559	<1.	0.176	<0.005	0.005	0.384	0.014	<0.05	0.013
AGDGRAND	03/10/87	7:45	13.0	7.1	6.6	852	<1.	0.055	<0.005	0.007	0.382	0.023	<0.05	0.016
AGDGRAND	04/16/87	6:30	17.0	7.0	6.2	358	<1.	0.165	<0.005	<0.005	0.148	0.021	<0.05	0.005
AGDGRAND	05/20/87	6:30	17.0	7.3	8.2	251	<1.	0.129	<0.005	0.009	0.066	0.022	<0.05	<0.005
AGDGRAND	06/11/87	6:40	20.0	7.3	6.3	398	<1.	0.167	<0.005	<0.005	0.065	0.007	<0.05	<0.005
AGDGRAND	09/03/87	9:30	23.1	7.3	5.0	499	<1.	0.087	<0.005	<0.005	0.105	0.082	<0.05	<0.005
AGDGRAND	10/08/87	6:30	16.5	7.3	7.2	364	<1.	0.062	<0.005	<0.005	0.208	0.018	<0.05	<0.005
AGDGRAND	10/08/87	7:00	17.2	7.1	7.5	340	<1.		<0.005	<0.005	0.222	0.033	<0.05	<0.005
AGDGRAND	11/03/87	7:20	13.5	7.2	7.0	441	<1.	0.238	<0.005	0.005	0.061	0.032	<0.05	0.007
AGDGRAND	12/01/87	7:30	10.6	7.3	9.1	436	<1.	0.117	<0.005	<0.005	0.189	0.017	<0.05	<0.005
AGDTYLER	07/09/86	9:30	23.5	7.3	0.5	966	<1.	2.600	<0.005	0.010	1.200	0.020	<0.05	0.020
AGDTYLER	08/13/86	9:45	21.5	6.8	2.6	279	<1.	0.900	<0.005	0.020	0.320	0.030	<0.05	0.010
AGDTYLER	09/11/86	9:45	20.5	7.3	5.5	369	<1.	0.320	<0.005	0.010	0.260	<0.005	<0.05	<0.005
AGDTYLER	11/19/86	8:45	14.0	7.1	4.4	804	<1.	0.466	<0.005	0.011	0.704	0.036	<0.05	0.009
AGDTYLER	12/10/86	8:55	9.0	7.3	10.4	829	<1.	0.368	<0.005	0.008	0.628	0.015	<0.05	<0.005
AGDTYLER	01/13/87	9:00	6.0	7.1	7.6	746	<1.	0.356	<0.005	0.008	0.896	0.029	<0.05	0.007
AGDTYLER	02/10/87	8:30	12.5	6.9	5.5	647	<1.	0.632	<0.005	0.009	0.556	0.023	<0.05	0.017
AGDTYLER	03/10/87	9:00	12.5	6.8	6.4	1100	<1.	0.340	<0.005	<0.005	1.000	0.008	<0.05	0.013

Note: "<" sign signifies concentration of analyte below reporting limit.
Blank lines in table indicate test not run.

TABLE G-2

MINOR ELEMENTS DATA REPORT

STA. NAME	SAMP.DATE	TIME	TEMP oC	PH	DO mg/L	EC uS/cm	Ba mg/L	Fe mg/L	Cr mg/L	Cu mg/L	Mn mg/L	Zn mg/L	Li mg/L	Ni mg/L
AGDTYLER	04/16/87	7:15	17.0	7.2	6.8	310	<1.	0.067	<0.005	0.007	0.168	0.012	<0.05	<0.005
AGDTYLER	05/20/87	7:15	16.5	7.4	7.2	249		0.110	<0.005	0.008	0.110	0.010	<0.05	0.006
AGDTYLER	06/11/87	7:45	21.0	7.3	6.4	198		0.314	<0.005	<0.005	0.052	0.032	<0.05	<0.005
BANKS	08/17/87	11:15	21.9	7.4	7.6	639	<1.	0.035	<0.005	<0.005	0.027	0.018	<0.05	<0.005
NATOMAS	09/24/87	7:00	18.2	7.4	5.7	614	<1.	0.024	<0.005	<0.005	0.039	0.029	<0.05	<0.005
NATOMAS	10/28/87	7:20	19.5	7.3	5.5	334	<1.	0.051	<0.005	<0.005	0.045	0.017	<0.05	<0.005
NATOMAS	11/24/87	7:45	11.5	7.4	6.7	746	<1.	0.014	<0.005	<0.005	0.057	0.029	<0.05	<0.005
NATOMAS	11/24/87	8:30	11.7	8.0	6.6	746	<1.	0.009	<0.005	<0.005	0.050	0.031	<0.05	<0.005
NATOMAS	12/16/87	10:30	7.7	7.5	10.3	704	<1.	0.268	<0.005	<0.005	0.142	0.011	<0.05	<0.005
VERNALIS	07/02/86	6:50	23.0	7.5	7.9	595	<1.	0.060	<0.005	<0.005	0.020	<0.005	0.01	<0.005
VERNALIS	08/14/86	7:15	21.5	7.6	7.6	557	<1.	0.050	<0.005	0.010	0.020	<0.005	0.01	<0.005
VERNALIS	09/24/86	7:00	17.5	7.3	8.2	317	<1.	0.050	<0.005	<0.005	0.020	<0.005	<0.05	<0.005
VERNALIS	11/12/86	7:45	13.5	7.3	9.7	447	<1.	0.032	<0.005	0.006	0.036	0.033	<0.05	<0.005
VERNALIS	12/17/86	11:30	11.5	7.3	10.5	331	<1.	0.033	<0.005	<0.005	0.031	0.010	<0.05	<0.005
VERNALIS	01/22/87	11:20	8.5	7.3	11.1	679		0.018	<0.005	<0.005	0.054	0.012	<0.05	<0.005
VERNALIS	02/24/87	11:15	11.5	7.5	9.9	868		0.016	<0.005	<0.005	0.054	0.006	<0.05	<0.005
VERNALIS	03/24/87	10:45	13.0	7.3	9.6	831	<1.	0.108	<0.005	<0.005	0.028	0.014	<0.05	<0.005
VERNALIS	04/30/87	9:45	19.0	7.3	8.4	564	<1.	0.027	<0.005	<0.005	0.029	0.008	<0.05	<0.005
VERNALIS	05/28/87	6:45	18.0	7.4	8.2	622		0.320	<0.005	<0.005	0.019	0.011	<0.05	<0.005
VERNALIS	06/23/87	7:15	22.5	7.7	4.6	807	<1.	0.324	0.006	<0.005	0.208	0.014	<0.05	0.008
VERNALIS	09/09/87	7:00	21.5	6.8	7.2	734	<1.	0.084	<0.005	0.006	0.072	0.121	<0.05	<0.005
VERNALIS	10/22/87	6:58	18.5	7.4	8.2	807	<1.	0.045	<0.005	0.007	0.031	0.018	<0.05	<0.005
VERNALIS	11/05/87	7:20	15.0	7.6	8.7	951	<1.	0.024	<0.005	<0.005	0.029	0.061	<0.05	<0.005
VERNALIS	12/08/87	8:00	13.6	7.4	9.4	974	<1.	0.021	<0.005	<0.005	0.028	0.011	<0.05	<0.005

Note: "<" sign signifies concentration of analyte below reporting limit.
Blank lines in table indicate test not run.

TABLE G-3
THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	THM Formation Potential: $CHCl_3$ ug/L	$CHBrCl_2$ ug/L	$CHBr_2Cl$ ug/L	$CHBr_3$ ug/L	TTHMFP ug/L	FLOW cfs
AGDEMPIRE	02/06/85	6.	7.3	9.8	252	685	2610	26	25		1500	920	930	81	3431	-
AGDEMPIRE	04/05/85	21.5	7.3	3.9	224	517	2180	10	75		1800	920	370	31	3121	-
AGDEMPIRE	05/01/85	20.	7.6	6.5	248	566	2280	14	160		1800	900	440	29	3169	-
AGDEMPIRE	06/05/85	20.	7.3	4.	54	95	629	15	75		1800	280	25	ND	2105	-
AGDEMPIRE	07/24/85	23.	6.8	4.1	42	69	472	10	40		2100	140	19	ND	2259	-
AGDEMPIRE	08/01/85	22.	6.8	5.5	32	44	360	8	100	22.	2100	150	10	ND	2260	-
AGDEMPIRE	09/11/85	19.5	6.9	4.5	83	172	886	4	150	19.	3000	460	48	2	3510	-
AGDEMPIRE	10/02/85	18.	7.6	7.6	149	376	1640	10	50	18.	2200	790	330	26	3346	-
AGDEMPIRE	11/13/85	7.	7.3	9.	170	452	1880	4	80	34.	2100	920	390	40	3450	-
AGDEMPIRE	12/03/85	14.	7.	5.4	87	186	1070	8	200	44.	2900	360	44	1	3305	-
AGDEMPIRE	01/16/86	12.	6.8	5.8	112	228	1087	3	160	31.	6900	490	67	1	7458	-
AGDEMPIRE	02/13/86	14.	6.8	6.7	162	396	1880	11	150	40.	2600	650	170	8	3428	-
AGDEMPIRE	03/04/86	19.5	7.3	8.	233	595	2840	7	200	65.	1500	660	210	14	2384	-
AGDEMPIRE	04/17/86	15.	7.4	8.8	148	357	1610	10	160	47.	1900	830	320	13	3063	-
AGDEMPIRE	05/13/86	21.5	7.5	6.6	204	506	2000	15	150	61.	570	330	160	15	1075	-
AGDEMPIRE	06/11/86	22.	8.1	5.7	296	830	2760	14	80	44.	410	310	230	48	998	-
AGDEMPIRE	07/09/86	20.5	6.9	5.4	23	30	283	10	100	72.	1400	94	4	ND	1498	-
AGDEMPIRE	08/13/86	20.5	7.1	5.1	24	37	281	9	50	19.						-
AGDEMPIRE	09/11/86	20.5	7.3	5.2	192	548	2120	10	80	19.	1400	1000	620	78	3098	-
AGDEMPIRE	11/19/86	16.	6.3	2.3	64	121	808	3	360	56.	5300	120	5	ND	5425	-
AGDEMPIRE	12/10/86	12.	6.3	3.	66	128	866	4	280	48.						-
AGDEMPIRE	01/13/87	7.5	6.3	1.7	75	173	996	3	300	60.	3200	190	23	15	3428	-
AGDEMPIRE	02/10/87	11.5	6.6	3.5	132	332	1660	8	200	54.	2900	410	160	6	3476	-
AGDEMPIRE	03/10/87	13.5	6.8	3.	216	542	2390	124	120	33.	1100	72	95	15	1282	-
AGDEMPIRE	04/16/87	21.5	7.5	7.2	222	638	2510	17	125	28.	2900	1300	500	74	4774	-
AGDEMPIRE	05/06/87	23.	7.9	7.5						28.	1200	740	570	200	2710	-
AGDEMPIRE	05/27/87	19.5	6.6	5.3	32	53	408	14								-
AGDEMPIRE	06/11/87	21.	6.9	6.4	36	64	503	19	60	10.	960	130	17	ND	1107	-
AGDEMPIRE	08/07/87	21.3	6.6	2.4	54	115	732	4		36.	3500	420	38	4	3962	-
AGDEMPIRE	09/24/87	19.3	7.3	3.6	274	700	2960	9			1200	780	570	130	2680	-
AGDEMPIRE	10/19/87	16.	7.1	2.	174	429	1720	9	60	16.	960	560	230	36	1786	-
AGDEMPIRE	10/28/87	19.	7.2	2.1	122	310	1340	161	809	22.	1010	471	119	22	1622	-
AGDEMPIRE	11/24/87	12.5	7.2	8.1	21	14	312	24	60		1500	39	1	1	1541	-
AGDEMPIRE	12/16/87	8.2	6.5	6.3					250	94.	2790	130	6	ND	2926	-
AGDGRAND	02/06/85	11.5	7.1	7.5	43	35	576	34	25		2100	32	4	ND	2136	-
AGDGRAND	04/05/85	18.5	7.3	5.	53	39	625	30	80		2000	100	4	ND	2104	-
AGDGRAND	05/01/85	18.5	6.9	5.7	23	13	310	26	50		1000	41	ND	ND	1041	-
AGDGRAND	06/05/85	21.	7.3	6.6	20	12	265	22	35		840	37	ND	ND	877	-
AGDGRAND	07/24/85	22.5	7.2	5.5	22	16	267	70	80		1800	60	2	ND	1862	-
AGDGRAND	08/01/85	21.5	7.1	6.5	22	13	273	30	50	17.	1300	49	1	ND	1350	-
AGDGRAND	09/11/85	19.5	7.2	6.1	31	33	451	28	30	14.	1100	94	8	ND	1202	-
AGDGRAND	10/02/85	19.	7.2	6.	27	19	327	25	30	4.5	820	56	3	ND	879	-
AGDGRAND	11/13/85	12.5	7.3	4.5	29	22	368	16	35	9.	890	69	3	ND	962	-
AGDGRAND	12/03/85	13.	7.	3.8	55	49	735	31	100	39.	2800	160	5	ND	2965	-
AGDGRAND	01/16/86	13.5	7.3	7.3	64	51	716	26	80	20.	3500	130	6	ND	3636	-
AGDGRAND	02/27/86	17.5	7.	4.4	35	27	602	24	100	28.	1700	83	2	ND	1785	-

TABLE G-3
THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> $CHCl_3$ <--------------	$CHBrCl_2$	$CHBr_2Cl$ ug/L	$CHBr_3$ ------------>	TTHMFP	FLOW cfs
AGDGRAND	03/13/86	14.5	6.6	5.8	64	57	1060	22	160	56.	3200	180	5	ND	3385	-
AGDGRAND	04/23/86	18.5	7.3	7.6	32	29	513	54	50	23.	1700	82	2	ND	1784	-
AGDGRAND	05/28/86	22.5	7.3	7.4	21	16	323	36	50	38.	640	29	3	1	673	-
AGDGRAND	06/25/86	24.5	7.2	6.8	20	15	290	35	40	9.2	450	30	2	1	483	-
AGDGRAND	07/23/86	22.5	7.1	6.	15	10	210	24	40	18.						-
AGDGRAND	08/27/86	23.5	7.2	7.6	17	11	250	24	50	29.	1400	35	ND	ND	1435	-
AGDGRAND	09/09/86	18.5	7.1	3.	37	22	378	18	15	12.	240	30	3	ND	273	-
AGDGRAND	11/19/86	14.5	7.3	5.8	18	12	237	14	5	1.7	320	16	2	ND	338	-
AGDGRAND	12/10/86	10.	7.1	8.1	33	18	366	30	50	11.	1400	30	ND	ND	1430	-
AGDGRAND	01/13/87	7.	7.1	7.9	34	23	458	21	80	14.	1900	56	2	2	1960	-
AGDGRAND	02/10/87	14.5	7.2	7.4	42	32	559	38	75	20.	2400	77	ND	ND	2477	-
AGDGRAND	03/10/87	13.	7.1	6.6	54	49	852	76	120	28.	1300	74	2	3	1379	-
AGDGRAND	03/10/87	13.	7.1	6.6	45	50	853	66	120	28.	1400	67	2	3	1472	-
AGDGRAND	04/16/87	17.	7.	6.2	21	17	358	28	30	7.8	1400	79	5	ND	1484	-
AGDGRAND	05/20/87	17.	7.3	8.2	18	12	251	38	30	5.4	800	30	ND	ND	830	-
AGDGRAND	06/11/87	20.	7.3	6.3	33	27	398	29	30	5.5	920	62	5	ND	987	-
AGDGRAND	09/03/87	23.1	7.3	5.	44	41	499	22	35	7.8	1200	58	7	ND	1265	-
AGDGRAND	10/08/87	16.5	7.3	7.2	26	23	364	30	40	6.3	810	47	2	2	861	-
AGDGRAND	10/08/87	16.5	7.3	7.2	20	15	340	30	40	6.8	1200	38	ND	ND	1238	-
AGDGRAND	11/03/87	13.5	7.2	7.	31	20	441	29	60		2400	73	1	ND	2474	-
AGDGRAND	12/01/87	10.6	7.3	9.1	30	20	436	26	60	15.	1900	43	3	3	1949	-
AGDTYLER	04/24/85	19.5	7.3	5.8	56	100	743	28	100		2100	260	27	ND	2387	-
AGDTYLER	05/22/85	21.5	7.2	4.7	23	31	320	17	70		1800	91	4	ND	1895	-
AGDTYLER	06/26/85	24.	6.8	5.5	15	10	188	18	50		1400	45	3	ND	1448	-
AGDTYLER	07/10/85	25.5	7.	4.5	14	8	189	17	100		1600	51	1	ND	1652	-
AGDTYLER	08/28/85	23.5	7.3	6.7	21	20	299	9	100	38.	2100	78	3	ND	2181	-
AGDTYLER	09/11/85	19.5	7.2	6.1	24	31	354	10	50	27.	2200	ND	6	ND	2206	-
AGDTYLER	10/02/85	17.5	6.9	3.2	26	18	289	14	100	15.	1200	70	2	ND	1272	-
AGDTYLER	11/13/85	6.	6.8	8.1	28	35	376	11	160	19.	2000	120	2	ND	2122	-
AGDTYLER	12/03/85	12.5	7.	3.7	36	58	587	12	100	64.	2100	85	2	ND	2187	-
AGDTYLER	01/16/86	11.	6.9	4.6	38	48	476	9	120	35.	3500	83	8	ND	3591	-
AGDTYLER	06/11/86	19.5	7.3	7.9	10	9	158	768	240	46.	1300	66	4	1	1371	-
AGDTYLER	07/09/86	23.5	7.3	0.5	75	114	966	18	400	170.	1400	160	13	ND	1573	-
AGDTYLER	08/13/86	21.5	6.8	2.6	21	22	279		150	40.						-
AGDTYLER	09/11/86	20.5	7.3	5.5	24	33	369	38	100	12.	2200	100	3	ND	2303	-
AGDTYLER	11/19/86	14.	7.1	4.4	55	103	804	21	150	26.	4100	180	13	ND	4293	-
AGDTYLER	12/10/86	9.	7.3	10.4	58	117	829	26	60	23.	3700	310	23	ND	4033	-
AGDTYLER	01/13/87	6.	7.1	7.6	56	109	746	29	120	20.	2100	100	5	ND	2205	-
AGDTYLER	02/10/87	12.5	6.9	5.5	42	73	647	25	100	24.	2200	97	ND	ND	2297	-
AGDTYLER	03/10/87	12.5	6.8	6.4	71	129	1100	60	100	36.	1300	80	2	8	1390	-
AGDTYLER	04/16/87	17.	7.2	6.8	16	18	310	72	35	7.5	1300	95	2	ND	1397	-
AGDTYLER	05/20/87	16.5	7.4	7.2	18	14	249	18	105	12.	1600	51	ND	ND	1651	-
AGDTYLER	06/11/87	21.	7.3	6.4	12	9	198	27	30	4.2	800	20	ND	ND	820	-
AGDTYLER	06/24/87	22.5	6.8	5.6						6.4	1000	59	5	ND	1064	-
AMERICAN	07/21/83	17.	7.3	10.	2	1	35	1	2	1.2	230	3	ND	ND	233	5000.
AMERICAN	08/18/83	19.	7.3	10.1	2	1	36	1	2	1.2	210	16	2	ND	228	4500.

TABLE G-3

THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> $CHCl_3$ <------	$CHBrCl_2$	$CHBr_2Cl$ ug/L	$CHBr_3$	TTHMFP ---->	FLOW cfs
AMERICAN	09/13/83	19.5	7.2	9.2	2	1	39	2	ND	1.	220	4	ND	ND	224	4000.
AMERICAN	10/04/83	20.	7.1	9.1	2	1	42	1	5	1.8	160	11	ND	ND	171	3500.
AMERICAN	11/01/83	17.	7.1	9.	2	1	40	2	5	1.2	150	4	ND	ND	154	2500.
AMERICAN	12/06/83	11.	7.2	11.8	2	1	46	9	12	2.3	270	4	ND	ND	274	8570.
AMERICAN	01/10/84	9.	7.	11.9	2	1	50	10	10	1.1	200	4	ND	ND	204	8380.
AMERICAN	02/01/84	9.5	7.1	11.9	2	2	53	4	5	1.	200	4	ND	ND	204	3080.
AMERICAN	03/07/84	9.5	7.3	11.6	2	1	57	3	2	1.3	260	17	ND	ND	277	3980.
AMERICAN	04/04/84	11.	7.1	11.4	2	1	55	2	2	1.2	200	5	ND	ND	205	4370.
AMERICAN	05/02/84	12.5	7.1	11.7	2	1	54	1	2	1.3	160	4	ND	ND	164	2440.
AMERICAN	06/06/84	15.	7.3	10.3	2	2	52	3	2	1.	270	10	1	ND	281	4070.
AMERICAN	07/10/84	18.	7.3	9.4	2	1	48	1	ND	1.2	290	4	ND	ND	294	4920.
AMERICAN	08/01/84	19.5	7.2	9.1	2	1	46	1	2	1.2	310	4	ND	ND	314	4890.
AMERICAN	09/05/84	22.	7.2	8.6	2	1	51	1	2	1.3	320	5	ND	ND	325	1470.
AMERICAN	10/04/84	19.5	7.1	9.1	2	1	42	2	2	1.2	160	5	ND	ND	165	2220.
AMERICAN	11/08/84	16.	7.	9.3	2	2	51	11	15	3.2	280	5	ND	ND	285	1730.
AMERICAN	12/05/84	11.	7.3	11.2	2	2	59	6	5	1.5	180	4	ND	ND	184	5020.
AMERICAN	02/13/85	10.	7.3	11.9	2	2	63	2	15		230	6	ND	ND	236	1740.
AMERICAN	04/10/85	14.5	7.3	10.5	3	2	67	2	ND		180	6	ND	ND	186	1270.
AMERICAN	05/08/85	14.	7.3	10.7	3	2	62	1	5		240	3	ND	ND	243	3730.
AMERICAN	06/12/85	18.5	7.3	9.9	2	2	60	2	ND		290	5	1	ND	296	2800.
AMERICAN	08/14/85	20.	7.2	9.1	2	2	56	1	2	1.5	210	8	ND	ND	218	3350.
AMERICAN	10/09/85	16.5	7.2	9.2	2	2	52	1	ND	1.4	180	5	ND	ND	185	1460.
AMERICAN	12/03/85	12.5	7.2	10.5	3	2	64	6	5	2.	260	6	ND	ND	266	1440.
AMERICAN	03/11/86	12.	7.1	12.	2	1	56	76	25	3.3	370	5	ND	ND	375	28200.
AMERICAN	04/17/86	14.5	7.3	11.2	2	1	55	6	15	1.4	300	5	ND	ND	305	5920.
AMERICAN	05/13/86	16.5	7.3	10.	2	2	53	3	25	1.4	190	6	1	ND	197	2500.
AMERICAN	06/11/86	16.5	7.3	10.	2	2	46	3	15	1.9	150	9	4	2	165	2980.
AMERICAN	07/09/86	17.5	7.1	9.7	2	2	46	2	5	1.7	210	4	ND	ND	214	4540.
AMERICAN	08/13/86	20.5	7.2	9.3	2	1	50		5	2.1						4559.
AMERICAN	09/11/86	22.	7.3	8.5	2	2	52	2	5	2.1	160	4	ND	ND	164	500.
AMERICAN	11/05/86	16.	6.9	10.2	2	1	46	1	5	1.8	240	4	ND	ND	244	1850.
AMERICAN	12/03/86	12.5	7.3	9.2	2	2	51	1	ND	1.2	250	6	ND	ND	256	1700.
AMERICAN	01/08/87	9.	7.1	12.	2	1	64	3	ND	1.	230	6	ND	ND	236	1080.
AMERICAN	02/05/87	10.	6.9	11.2	2	2	70	2	ND	1.1	190	4	ND	ND	194	933.
AMERICAN	03/03/87	11.	7.5	11.3	2	2	69	1	ND	1.7	250	19	ND	ND	269	958.
AMERICAN	04/09/87	16.	7.2	9.2	3	2	69	2	5	1.2	240	9	ND	ND	249	1190.
AMERICAN	05/13/87	19.5	7.2	8.5	2	2	80	2	5	1.8	240	10	1	ND	251	992.
AMERICAN	06/04/87	18.	7.3	9.4	3	2	85	3	5	1.2	170	6	ND	ND	176	1000.
AMERICAN	09/24/87	17.	6.8	8.3	2	2	78	2	5	1.6	370	12	4	1	387	3472.
AMERICAN	10/28/87	20.	7.1	8.2	4	3	73	2	ND	2.3	193	5	ND	ND	198	1256.
AMERICAN	11/24/87	10.5	8.	9.5	2	2	66	1	ND	1.6	140	4	ND	ND	144	1030.
AMERICAN	12/16/87	11.	7.1	9.3	5	3	81	2	5	1.7	120	5	ND	ND	125	1054.
BANKS	02/24/83	14.	7.4	9.3		30	288	10			190	26	4	ND	220	6119.
BANKS	04/27/83		7.3	8.4		42	367	6			360	69	10	6	445	125.
BANKS	06/22/83	20.5	7.2	8.4		14	143	11			350	28	4	ND	382	2262.
BANKS	07/26/83	23.	7.3	8.3	21	22	211	17	8	2.8	300	38	6	ND	344	1306.

TABLE G-3

THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> $CHCl_3$ ug/L	$CHBrCl_2$ ug/L	$CHBr_2Cl$ ug/L	$CHBr_3$ ug/L	TTHMFP ug/L	FLOW cfs
BANKS	08/23/83	22.5	7.3	8.	25	28	261	17	8	3.5	420	58	9	ND	487	2179.
BANKS	09/14/83	22.	7.3	7.	22	24	226	8	20	2.9	330	38	8	ND	376	61.
BANKS	10/12/83	20.5	7.3	7.6	23	26	219	6	20	3.1	260	47	8	4	319	306.
BANKS	11/08/83	16.5	7.2	8.6	19	20	186	7	25	2.8	310	40	7	ND	357	1154.
BANKS	12/13/83	12.	7.3	10.2	32	34	305	13	40	3.3	360	42	7	ND	409	326.
BANKS	01/24/84	9.5	7.3	11.2	26	28	252	5	20	2.9	320	44	8	ND	372	267.
BANKS	02/28/84	12.	7.5	10.	42	46	388	5	20	3.2	310	75	20	ND	405	2563.
BANKS	03/27/84	16.5	7.3	9.8	36	40	370	20	30	4.2	460	80	16	ND	556	104.
BANKS	04/25/84	15.	7.3	9.3	27	30	283	37	25	3.9	570	62	12	ND	644	3925.
BANKS	05/30/84	23.	7.5	7.1	29	33	304	16	12	4.7	400	72	18	ND	490	1865.
BANKS	06/27/84	24.5	7.3	6.6	24	34	258	29	40	4.9	410	59	8	ND	477	2884.
BANKS	07/25/84	23.	7.4	8.1	20	23	214	16	20	4.7	420	57	9	ND	486	4359.
BANKS	08/29/84	23.	7.3	7.4	22	24	244	7	18	3.1	360	55	10	ND	425	3438.
BANKS	09/27/84	22.5	7.3	8.6	25	25	268	7	15	3.3	370	55	10	ND	435	1723.
BANKS	10/25/84	16.5	7.7	9.3	25	26	266	8	20	2.9	300	59	9	ND	368	903.
BANKS	11/29/84	11.5	7.5	10.5	20	21	233	11	30	3.3	430	44	6	ND	480	2797.
BANKS	12/12/84	11.5	7.3	10.	23	24	263	10	25	4.3	380	50	6	ND	436	4258.
BANKS	02/27/85	13.5	7.5	9.5	30	33	335	8	35		310	71	10	ND	391	4151.
BANKS	04/24/85	17.5	7.6	8.7	36	34	351	11	5		410	81	17	ND	508	4520.
BANKS	05/22/85	19.5	8.1	8.6	35	41	351	26	5		580	90	17	ND	687	1917.
BANKS	06/26/85	23.5	7.7	7.5	38	46	370	32	20		550	110	24	1	685	5222.
BANKS	07/10/85	24.5	7.5	7.5	42	48	343	16	15		590	160	35	2	787	4572.
BANKS	08/28/85	22.5	7.4	7.8	54	78	466	10	10	6.4	390	140	69	5	604	5260.
BANKS	09/25/85	22.5	7.5	7.9	69	102	588	6	10	2.7	340	89	40	10	479	3020.
BANKS	09/25/85	22.5	7.5	7.9	70	102	584	6	5	6.5	290	170	63	13	536	-
BANKS	10/23/85	17.	7.6	8.9	59	94	527	7	5	4.	290	150	90	13	543	3200.
BANKS	11/15/85	12.	7.4	9.5	71	112	586	6	10	2.9	260	160	100	ND	520	2150.
BANKS	12/03/85	11.5	7.4	10.1	85	141	676	10	10	3.6	240	210	150	10	610	6320.
BANKS	01/23/86	12.	7.3	9.2	56	79	482	12	25	7.2	1700	170	47	2	1919	5170.
BANKS	02/13/86	11.5	7.7	10.5	45	61	444	17	25	8.6	780	140	28	1	949	2770.
BANKS	03/04/86	16.5	7.3	8.2	30	33	332	14	30	5.8	600	70	6	ND	676	1870.
BANKS	04/09/86	17.5	7.5	9.4	29	31	265	13	20	5.	630	76	10	ND	716	750.
BANKS	05/07/86	15.5	7.3	8.9	28	31	284	11	15	5.	460	74	10	ND	544	2600.
BANKS	06/04/86	19.5	7.5	8.6	31	38	312	32	20	5.9	340	45	9	ND	394	2590.
BANKS	07/02/86	24.	7.3	6.4	31	33	305	25	15	4.7	470	78	17	ND	565	4430.
BANKS	08/14/86	24.	7.3	7.7	27	32	280	22	15	18.						5190.
BANKS	09/24/86	19.5	7.5	8.6	10	34	297	22	10	7.1	360	89	19	ND	468	6360.
BANKS	11/12/86	14.	7.4	9.7	20	23	236	13	15	1.9	340	35	9	ND	384	3140.
BANKS	12/17/86	10.	7.3	10.1	32	31	278	9	15	1.6	350	58	7	ND	415	3350.
BANKS	01/22/87	6.5	7.3	12.	28	34	309	14	20	3.8	650	68	7	ND	725	-
BANKS	02/24/87	11.5	7.3	10.7	41	55	446	9	20	4.3	630	160	41	ND	831	-
BANKS	02/24/87	11.5	7.3	10.7	39	55	443	9	20	4.3	630	98	43	ND	771	-
BANKS	03/24/87	13.	7.5	9.7	57	69	568	8	25	5.	470	120	18	8	616	-
BANKS	04/30/87	18.5	8.4	10.	34	38	396	10	15	3.2	240	57	8	ND	305	-
BANKS	05/28/87	18.	7.4	11.	39	52	397	28	15	2.5	450	120	30	ND	600	-
BANKS	06/23/87	22.5	7.6	8.3	51	75	487	19	15		390	150	75	16	631	-

TABLE G-3

THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> CHCl3	CHBrCl2	CHBr2Cl	CHBr3	TTHMFP	FLOW cfs
											<--------------	---- ug/L	----	---------->		
BANKS	09/09/87	21.5	7.2	7.4	77	124	626	12	5	4.	250	140	82	20	492	-
BANKS	09/09/87	21.5	7.2	7.4	77	124	628	12		3.7	450	160	74	12	696	-
BANKS	10/22/87	19.5	7.4	7.9	116	173	814	5	ND	3.9	130	120	100	29	379	-
BANKS	11/05/87	17.5	7.4	8.7	91	143	703	6	5	2.7	250	100	50	21	421	-
BANKS	12/08/87	12.6	7.4	9.8	113	180	835	4	15	2.7	440	180	96	25	741	-
BARKER	09/03/87	20.5	7.3	5.5	33	23	734	65		6.7	1100	48	1	ND	1149	-
BARKER	10/08/87	19.8	7.4	7.6	39	28	561	36	25	4.2	750	32	1	ND	783	-
BARKER	11/03/87	14.5	7.3	7.1	49	35	561	19	10	6.5	670	42	1	ND	713	-
BARKER	12/01/87	11.3	7.5	10.2	54	46	599	16	15	5.8	590	39	3	2	634	-
CACHE	01/31/84	11.5	8.3	12.4	85	88	976	13	8	5.5	300	85	31	2	418	-
CACHE	02/22/84	12.5	8.1	10.4	82	82	896	76	15	6.4	360	87	26	1	474	-
CACHE	03/14/84	16.5	8.1	8.4	79	80	897	14	15	7.6	270	82	27	ND	379	-
CACHE	04/11/84	15.5	8.6	10.1	59	57	720	20	10	8.	500	81	18	ND	599	-
CACHE	05/23/84	21.	8.3	9.	36	34	488	34	30	6.7	570	63	8	ND	641	-
CACHE	06/13/84	19.	8.2	8.5	42	42	595	52	30	7.	760	83	8	ND	851	-
CACHE	07/11/84	24.5	8.3	8.5	36	34	541	46	25	8.4	800	64	4	ND	868	-
CACHE	08/22/84	21.5	8.1	7.5	32	29	495	90	50	7.1	600	51	4	ND	655	-
CACHE	09/12/84	23.	8.1	8.9	39	38	577	20	30	8.4	630	64	5	ND	699	-
CACHE	10/11/84	19.5	8.2	7.8	44	42	594	29	25	6.	850	69	6	ND	925	-
CACHE	11/15/84	12.5	7.4	7.7	38	38	460	95	30	9.	730	47	4	ND	781	-
CACHE	12/06/84	10.5	7.9	8.8	64	64	744	50	50	8.5	720	87	10	ND	817	-
CACHE	04/10/85	16.	8.3	9.5	63	62	713	24	10		640	88	16	ND	744	-
CACHE	05/08/85	16.5	8.4	9.4	44	38	560	28	25		760	77	6	ND	843	-
CACHE	06/12/85	24.	8.1	7.1	35	33	499	50	20		870	43	5	ND	918	-
CLIFTON	07/26/83	21.	7.3	7.9	20	22	208	22	8	3.2	310	42	7	ND	359	1481.
CLIFTON	08/23/83	21.5	7.3	7.7	27	31	283	20	8	3.1	360	72	12	ND	444	2242.
CLIFTON	09/14/83	22.5	7.3	7.8	17	17	180	11	10	3.3	330	23	4	ND	357	0.
CLIFTON	10/12/83	20.	7.1	8.3	12	13	137	12	12	2.8	310	27	2	ND	339	0.
CLIFTON	11/08/83	16.	7.3	8.5	33	36	324	10	20	3.3	270	63	17	ND	350	652.
CLIFTON	12/13/83	12.	7.1	9.6	16	16	171	13	25	2.9	380	30	3	ND	413	0.
CLIFTON	01/24/84	10.	7.3	10.8	22	22	226	12	25	3.1	300	39	6	ND	345	0.
CLIFTON	02/28/84	13.	7.5	10.2	39	42	389	7	18	3.1	280	67	18	ND	365	2367.
CLIFTON	03/27/84	16.5	7.4	9.4	35	40	362	10	25	3.8	380	79	17	ND	476	2452.7
CLIFTON	04/25/84	16.5	7.3	9.3	27	30	288	12	15	3.8	320	56	13	ND	389	4199.1
CLIFTON	05/30/84	24.	7.1	7.4	29	33	307	19	20	4.9	420	67	15	ND	502	2779.4
CLIFTON	06/27/84	25.5	7.2	6.3	50	56	472	28	30	5.4	350	110	31	1	492	2994.7
CLIFTON	07/25/84	24.	7.5	8.6	18	21	212	18	25	4.4	420	52	8	ND	480	4753.7
CLIFTON	08/29/84	24.5	7.3	7.6	20	23	222	11	15	3.2	390	54	10	ND	454	3827.1
CLIFTON	09/27/84	22.	7.5	8.3	24	24	261	6	15	3.2	390	49	12	ND	451	1704.6
CLIFTON	10/25/84	17.	7.5	10.	27	29	284	7	18	3.4	300	54	14	ND	368	0.
CLIFTON	11/29/84	12.	7.3	10.2	20	21	233	11	30	3.7	460	48	6	ND	514	2400.
CLIFTON	12/12/84	11.5	7.3	10.	21	22	252	16	35	4.7	390	52	5	ND	447	5150.
CLIFTON	02/27/85	13.	7.3	9.8	26	28	303	14	40		410	64	8	ND	482	4200.
CLIFTON	04/24/85	18.	7.6	9.6	24	24	277	8	8		470	56	7	ND	533	4200.
CLIFTON	05/22/85	21.5	8.1	9.2	25	29	264	21	15		610	65	11	ND	686	2490.
CLIFTON	06/26/85	24.5	7.5	7.7	37	40	314	17	15		550	88	24	1	663	5290.

TABLE G-3
THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> $CHCl_3$	$CHBrCl_2$	$CHBr_2Cl$	$CHBr_3$	TTHMFP	FLOW cfs
											<--------------	ug/L		------------>		
CLIFTON	08/28/85	23.5	7.4	7.7	51	69	458	10	10	4.	460	110	47	3	620	5770.
CLIFTON	10/23/85	17.5	7.5	8.9	52	77	484	9	10	2.3	330	130	59	4	523	3490.
CLIFTON	12/03/85	12.	7.4	10.1	98	162	744	10	8	3.7	310	220	170	13	713	5960.
CLIFTON	03/04/86	16.5	7.3	7.8	29	29	306	21	20	8.	520	64	7	ND	591	1390.
CLIFTON	04/09/86	16.5	7.2	8.8	20	20	197	14	20	3.9	570	62	5	ND	637	1540.
CLIFTON	04/09/86	16.5	7.2	8.8	20	20	195	14	30	3.9	610	53	5	ND	668	-
CLIFTON	05/07/86	15.5	7.3	8.8	27	28	280	13	20	6.3	350	51	7	ND	408	2790.
CLIFTON	06/04/86	20.5	7.3	8.2	29	33	303	26		3.6	140	28	6	ND	174	2910.
CLIFTON	07/02/86	24.5	7.3	6.5	55	66	534	11	10	3.5	310	91	36	2	439	4900.
CLIFTON	08/14/86	24.5	7.4	7.4	61	71	571	15	5	5.3						5000.
CLIFTON	09/24/86	19.5	7.3	8.3	27	33	292	19	15	7.2	350	86	18	ND	454	6880.
CLIFTON	11/12/86	14.	7.3	9.7	24	29	276	13	10	2.2	350	43	14	ND	407	3470.
CLIFTON	12/17/86	10.	7.3	10.	32	32	285	11	5	2.1	430	60	7	ND	497	3150.
CLIFTON	01/22/87	6.5	7.3	11.5	26	32	300	19	15	4.1	730	26	2	ND	758	-
CLIFTON	02/24/87	11.5	7.3	10.1	38	51	435	11	20	4.7	780	96	34	ND	910	2608.
CLIFTON	03/24/87	13.5	7.3	9.6	77	91	730	10	10	4.2	400	140	27	ND	567	5602.
CLIFTON	04/30/87	20.	8.3	11.1	29	32	365	12	10	3.2	270	49	7	ND	326	1000.
CLIFTON	05/28/87	19.5	7.4	9.	39	58	401	20	10	2.4	420	140	36	ND	596	1473.
CLIFTON	06/23/87	23.	8.3	7.4	49	70	483	22	15		410	110	37	ND	557	1937.
CLIFTON	09/09/87	22.4	7.4	8.1	79	133	646	17	5	2.8	340	130	73	21	564	5300.
CLIFTON	10/22/87	19.5	7.4	7.3	95	165	777	6	ND	3.1	210	140	120	1	471	1668.
CLIFTON	11/05/87	18.	7.3	7.6	113	190	821	6	ND		180	67	78	13	338	1095.
CLIFTON	11/05/87	17.5	7.4	8.3	73	115	616	6	5		240	130	76	12	458	-
CLIFTON	12/08/87	11.3	7.4	10.2	108	182	847	7	20	3.3	260	150	93	22	525	1996.
DMC	07/26/83	23.	7.3	7.5	33	38	322	31	5	3.6	290	54	10	ND	354	4723.
DMC	08/23/83	21.5	7.3	7.7	28	31	283	22	5	3.2	400	59	9	ND	468	3573.
DMC	09/14/83	21.	7.3	7.8	18	18	188	19	12	2.4	310	26	4	ND	340	3245.
DMC	10/12/83	18.5	7.3	8.5	14	15	151	18	12	3.2	200	26	2	ND	228	2439.
DMC	11/08/83	16.5	7.2	8.2	37	39	361	11	20	3.4	270	48	14	ND	332	153.
DMC	12/13/83	12.	7.2	9.5	23	26	238	18	35	3.5	320	37	6	ND	363	3725.
DMC	01/24/84	10.5	7.3	10.7	30	33	297	16	35	3.2	340	52	11	ND	403	1198.
DMC	02/28/84	12.5	7.5	10.	42	48	397	11	18	3.1	280	76	25	1	382	4309.
DMC	03/27/84	16.	7.3	9.5	53	60	511	24	15	3.8	270	90	35	2	397	4402.
DMC	04/25/84	15.5	7.5	9.3	60	68	552	18	10	4.7	300	120	45	2	467	4071.
DMC	05/30/84	23.5	7.4	7.6	29	33	298	24	20	4.7	380	66	14	ND	460	2390.
DMC	06/27/84	25.5	7.3	6.	32	35	328	30	35	5.	380	70	15	ND	465	3313.
DMC	07/25/84	24.	7.7	7.4	58	73	554	28	15	4.4	450	150	57	4	661	4688.
DMC	08/29/84	24.5	7.3	7.3	21	22	229	16	18	3.7	330	48	9	ND	387	3027.
DMC	09/27/84	22.	7.4	8.2	28	29	296	13	15	3.8	330	55	12	ND	397	3150.
DMC	10/25/84	16.	7.8	9.8	25	26	268	8	20	3.3	360	66	12	ND	438	3959.
DMC	11/29/84	11.	7.4	10.2	32	34	321	9	25	4.1	400	64	12	ND	476	3901.
DMC	12/12/84	11.5	7.2	9.3	31	32	315	18	25	4.9	370	60	8	ND	438	4004.
DMC	02/27/85	13.	7.5	9.9	31	34	336	11	35		410	75	12	ND	497	4221.
DMC	04/24/85	17.5	7.5	9.5	25	24	280	9	5		340	57	5	ND	402	3997.
DMC	05/22/85	20.5	8.3	9.1	25	29	265	22	20		550	71	10	ND	631	3136.
DMC	06/26/85	24.5	7.6	7.1	78	95	710	23	10		580	180	9	10	779	2877.

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THM DATA REPORT

											<---- THM Formation Potential ---->					
		TEMP[2]	pH	DO	Na	Cl	EC	TURB	COL	TOC	$CHCl_3$	$CHBrCl_2$	$CHBr_2Cl$	$CHBr_3$	TTHMFP	FLOW
STA. NAME[1]	SAMP.DATE	°C[3]		mg/L	mg/L	mg/L	uS/cm	NTU	CU	mg/L	<----------------		ug/L	------------>		cfs
DMC	08/28/85	23.	7.4	7.7	50	74	441	17	20	9.7	410	120	70	3	603	4160.
DMC	10/23/85	16.5	7.4	7.2	60	79	592	13	5	3.6	270	110	58	5	443	3890.
DMC	12/03/85	12.	7.4	10.1	72	117	591	10	15	6.3	360	190	120	6	676	3940.
DMC	03/04/86	16.5	7.3	7.9	29	28	288	25	25	7.8	580	61	6	ND	647	3230.
DMC	04/09/86	16.	7.3	9.	23	27	229	22	25	4.2	600	58	7	ND	665	2070.
DMC	05/07/86	16.	7.2	8.3	27	28	278	15	10	6.2	260	40	5	ND	305	3300.
DMC	06/04/86	21.5	7.3	7.7	36	48	362	31		3.	250	54	8	ND	312	3340.
DMC	07/02/86	24.5	7.3	7.	54	62	530	13	10	4.8	340	120	34	2	496	4500.
DMC	08/14/86	24.5	7.3	6.6	63	73	586	27	5	2.4						4560.
DMC	09/24/86	18.5	7.3	8.1	32	35	320	18	10	4.8	340	81	20	ND	441	4010.
DMC	11/12/86	13.5	7.4	9.4	58	71	545	13	5	1.9	230	64	53	2	349	3279.
DMC	12/17/86	10.	7.2	9.6	35	34	299	11	5	2.1	400	66	9	ND	475	4108.
DMC	01/22/87	6.5	7.3	11.5	33	40	356	18	20	4.1	670	79	9	ND	758	-
DMC	02/24/87	10.5	7.3	9.7	88	102	860	11	10	3.6	480	190	120	7	797	4053.
DMC	03/24/87	13.	7.5	9.6	88	104	804	13	15	3.9	340	140	33	6	519	1742.
DMC	04/30/87	20.	8.3	10.3	29	32	359	18	10	3.1	280	51	8	ND	339	4620.
DMC	05/28/87	18.5	7.5	8.6	39	57	405	17	10	2.5	420	130	34	ND	584	1714.
DMC	05/28/87	18.5	7.5	8.6	40	57	408	18	10	2.4	370	120	33	ND	523	-
DMC	06/23/87	23.	7.5	7.5	49	70	466	22	10		400	120	44	ND	564	2616.
DMC	09/09/87	22.	7.4	7.7	59	90	503	21	5	3.5	410	110	43	8	571	4467.
DMC	10/22/87	19.	7.4	7.2	89	155	751	7	ND	3.3	87	68	34	33	222	3770.
DMC	11/05/87	18.	7.3	8.5	77	116	620	8	5		280	110	77	14	481	4059.
DMC	12/08/87	11.3	7.3	10.2	113	181	847	8	20	3.2	240	160	120	33	553	4097.
DVSR	09/20/83	14.5	7.3	5.3	15	12	414	2	8	2.9	450	16	2	0	468	-
DVSR	10/18/83	18.	8.	7.	17	13	430	1	8	2.9	0	0	0	0	0	-
DVSR	11/21/83	15.5	7.9	8.4	18	15	469	4	15	3.6	230	29	4	0	263	-
DVSR	03/11/86	13.	8.1	11.3	14	12	322	90	30	6.6	660	33	1	0	694	-
DVSR	05/13/86	16.	8.2	6.4	15	11	356	4	20	4.8	510	24	2	0	536	-
GREENES	07/21/83	19.5	7.3	8.7	7	4	115	9	2	1.6	190	8	1	ND	199	26400.
GREENES	08/18/83	21.	7.5	8.2	7	4	124	8	8	1.6	200	14	1	ND	215	24600.
GREENES	09/13/83	20.5	7.3	8.3	10	6	154	12	8	1.8	600	18	2	ND	620	23100.
GREENES	10/04/83	18.	7.3	9.	7	5	124	10	5	1.6	200	9	ND	ND	209	24800.
GREENES	11/01/83	17.	7.3	9.1	8	5	128	6	5	1.7	210	8	ND	ND	218	17700.
GREENES	12/06/83	10.5	7.4	10.6	4	4	122	30	30	4.1	300	9	ND	ND	309	66100.
GREENES	01/10/84	9.	7.3	10.7	7	4	129	19	20	1.7	220	10	1	ND	231	67200.
GREENES	02/01/84	10.	7.1	10.8	7	5	140	14	12	1.5	190	11	1	ND	202	32400.
GREENES	03/07/84	12.	7.5	10.8	10	7	164	8	8	1.6	230	28	1	ND	259	25800.
GREENES	04/04/84	13.5	7.5	10.4	9	6	148	8	5	1.6	250	14	1	ND	265	25100.
GREENES	05/02/84	16.	7.3	9.4	10	6	154	8	8	2.	180	13	1	ND	194	11200.
GREENES	06/06/84	18.	7.5	8.7	10	7	146	9	8	2.	250	15	1	ND	266	13900.
GREENES	07/10/84	22.5	7.4	8.2	7	4	121	11	5	1.6	260	10	ND	ND	270	21200.
GREENES	08/01/84	21.5	7.4	7.9	8	4	133	11	5	1.6	300	10	1	ND	311	22000.
GREENES	08/21/84	23.	7.3	8.2	11	6	164	12	10	1.8	250	16	1	ND	267	17800.
GREENES	09/05/84	22.	7.4	7.7	12	6	185	11	8	2.4	390	20	1	ND	411	18240.
GREENES	10/04/84	17.5	7.4	9.	8	4	132	7	5	1.6	170	13	1	ND	184	14500.
GREENES	11/08/84	14.	7.3	9.7	10	6	154	11	8	2.1	210	11	ND	ND	221	14800.

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THM DATA REPORT

											<---- THM Formation Potential---->					
		TEMP[2]	pH	DO	Na	Cl	EC	TURB	COL	TOC	$CHCl_3$	$CHBrCl_2$	$CHBr_2Cl$	$CHBr_3$	TTHMFP	FLOW
STA. NAME[1]	SAMP.DATE	°C[3]		mg/L	mg/L	mg/L	uS/cm	NTU	CU	mg/L	<--------------		ug/L	------------>		cfs
GREENES	12/05/84	10.5	7.4	10.9	9	6	160	24	15	2.6	240	14	1	ND	255	38100.
GREENES	02/06/85	8.	7.5	12.1	11	6	174	8	10		360	14	1	ND	375	14900.
GREENES	04/05/85	19.	7.4	9.3	13	6	176	7	2		160	13	ND	ND	173	13900.
GREENES	05/01/85	19.	7.3	8.8	11	7	167	11	10		210	12	1	ND	223	10200.
GREENES	06/05/85	21.	7.4	8.5	13	6	173	9	10		290	19	1	ND	310	15100.
GREENES	08/01/85	22.5	7.5	7.9	11	5	163	10	10	3.9	480	14	2	ND	496	15600.
GREENES	09/04/85	22.	7.3	7.8	15	8	207	8	5	3.5	220	22	2	ND	244	12500.
GREENES	10/02/85	21.5	7.5	8.2	14	8	168	7	5	1.6	200	14	1	ND	215	10600.
GREENES	11/13/85	12.	7.3	9.7	11	7	163	6	5	2.8	290	20	1	ND	311	9500.
GREENES	12/03/85	11.5	7.3	9.3	10	7	149	28	35	16.	690	21	1	ND	712	24200.
GREENES	01/16/86	10.	7.3	10.6	18	10	218	9	15	2.3	660	22	1	ND	683	14900.
GREENES	02/27/86	12.5	7.1	10.5	4	2	84	64	20	4.2	340	7	ND	ND	347	50600.
GREENES	02/27/86	12.5	7.1	10.5	4	2	84	63	10	2.9	320	8	ND	ND	328	-
GREENES	03/13/86	11.5	7.3	11.	3	2	70	58	10	2.4	430	8	ND	ND	438	90900.
GREENES	04/23/86	18.5	7.3	8.5	10	7	179	14	10	1.9	310	22	1	ND	333	17500.
GREENES	05/28/86	23.5	7.3	7.5	12	9	188	14	10	2.9	170	12	2	1	185	14000.
GREENES	06/25/86	24.5	7.3	7.8	11	8	161	13	15	3.3	990	10	3	2	1005	11300.
GREENES	07/23/86	22.5	7.3	7.8	8	5	128	13	5	5.5	ND					18200.
GREENES	08/27/86	24.5	7.6	7.3	12	7	179	10	10	5.4	220	17	1	ND	238	14400.
GREENES	09/09/86	22.5	7.3	7.7	13	7	182	12	5	4.7	220	17	1	ND	238	16400.
GREENES	11/19/86	14.5	7.3	10.	8	6	146	7	10	1.5	180	7	ND	ND	187	14500.
GREENES	12/10/86	11.	7.3	10.7	11	6	152	8	ND	1.5	210	13	ND	ND	223	15700.
GREENES	01/13/87	7.5	7.3	11.	11	7	178	8	5	1.7	200	12	ND	ND	212	11800.
GREENES	01/13/87	7.5	7.3	11.	11	7	178	8	5	1.8	220	15	ND	ND	235	11800.
GREENES	02/10/87	12.	7.3	9.4	14	10	193	15	10	2.3	470	19	ND	ND	489	14940.
GREENES	03/10/87	13.5	7.1	8.4	7	5	128	72	25	3.4	1100	10	ND	ND	1110	21654.
GREENES	04/16/87	16.5	7.2	5.6	10	7	178	8	5	1.4	260	18	2	ND	280	11890.
GREENES	05/20/87	20.	7.4	7.7	12	7	172	11	10	1.5	120	11	ND	ND	131	10200.
GREENES	06/11/87	21.	7.3	7.6	11	7	176	6	5	1.4	180	11	ND	ND	191	10300.
GREENES	08/25/87	21.3	7.3	8.2			181				250	13	13	ND	276	14200.
GREENES	08/26/87	21.6	7.3	8.			189				220	10	ND	ND	230	13600.
GREENES	09/03/87	23.7	7.1	9.	14	11	204	11	5	4.9	430	17	ND	ND	447	12100.
GREENES	10/08/87	20.	7.2	8.7	9	5	159	7	5	1.6	240	11	ND	ND	251	-
GREENES	11/03/87	16.5	7.1	8.1	12	9	180	4	ND	2.8	300	15	ND	ND	315	-
LCONNECTSL	02/06/85	7.	7.4	11.2	20	22	252	5	15		660	46	6	ND	712	-
LCONNECTSL	04/05/85	17.5	7.3	9.5	13	11	188	6	5		230	26	2	ND	258	-
LCONNECTSL	05/01/85	19.	7.4	9.1	13	11	175	5	5		280	27	2	ND	309	-
LCONNECTSL	06/05/85	20.5	7.5	8.7	13	10	180	7	5		300	26	2	ND	328	-
LCONNECTSL	08/01/85	22.5	7.4	8.	13	10	186	5	10	3.8	360	32	2	ND	394	-
LCONNECTSL	10/02/85	20.	7.5	7.8	18	11	209	4	5	3.1	240	26	3	ND	269	-
LCONNECTSL	11/13/85	11.5	7.3	9.	12	11	183	3	25	3.4	340	34	2	ND	376	-
LCONNECTSL	12/03/85	11.5	7.3	10.2	15	15	204	5	15	6.8	380	36	3	ND	419	-
LCONNECTSL	03/11/86	14.5	7.3	9.	12	19	192	22	25	17.	650	51	3	ND	704	-
LCONNECTSL	04/17/86	15.5	7.2	8.5	17	20	195	11	20	4.2	440	51	7	ND	498	-
LCONNECTSL	05/13/86	19.5	7.3	8.4	12	15	162	14	25	4.2	150	16	2	ND	168	-
LCONNECTSL	06/11/86	21.5	7.3	7.9	9	8	136	12	25	3.9	310	15	2	ND	327	-

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THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	$CHCl_3$ ug/L	$CHBrCl_2$ ug/L	$CHBr_2Cl$ ug/L	$CHBr_3$ ug/L	TTHMFP ug/L	FLOW cfs
											<---- THM Formation Potential---->					
LCONNECTSL	07/09/86	23.	7.3	7.7	10	10	154	9	10	5.	280	30	1	ND	311	-
LCONNECTSL	07/09/86	23.	7.3	7.7	10	11	153	8	10	6.2	310	67	2	ND	379	-
LCONNECTSL	08/13/86	21.5	7.3	7.8	10	10	153	9	10	3.7						-
LCONNECTSL	09/11/86	21.5	7.4	7.6	12	10	181	12	10	3.8	280	24	3	ND	307	-
LCONNECTSL	11/19/86	13.5	7.2	9.1	9	9	156	5	20	3.1	600	19	1	ND	620	-
LCONNECTSL	01/13/87	7.5	7.1	10.1	13	18	209	6	30	4.8	700	49	2	ND	751	-
LCONNECTSL	02/10/87	11.5	7.2	9.6	16	21	235	10	15	4.8	630	41	ND	ND	671	-
LCONNECTSL	03/10/87	13.5	7.1	9.1	16	25	261	14	35	4.7	1400	38	2	ND	1440	-
LCONNECTSL	04/16/87	19.5	7.2	6.8	13	16	228	6	5	2.3	290	35	5	ND	330	-
LCONNECTSL	05/20/87	21.5	7.4	8.5	13	12	194	9	5	1.7	280	28	3	ND	311	-
LCONNECTSL	06/11/87	22.5	7.8	8.	17	18	241	6	10	2.1	250	32	5	ND	287	-
LCONNECTSL	09/24/87	20.5	7.4	7.9	17	13	270	6	10	2.3	240	25	3	ND	268	-
LCONNECTSL	10/28/87	20.	7.2	7.4	21	28	242	4	5	2.9	199	49	15	ND	263	-
LCONNECTSL	10/28/87	20.	7.2	7.4	24	28	244	5	5	2.8	192	53	17	1	263	-
LCONNECTSL	12/11/87	8.2	7.3	11.3	14	11	178	18	40	4.4	800	19	2	ND	821	-
LINDSEY	07/11/84	24.5	8.4	6.7	37	29	426	36	35	6.3	770	57	6	ND	833	-
LINDSEY	08/22/84	21.5	8.	7.6	35	26	411	65	50	7.1	950	65	4	ND	1019	-
LINDSEY	09/12/84	22.5	7.6	7.	34	25	424	27	50	7.5	930	59	3	ND	992	-
LINDSEY	10/11/84	19.5	7.8	8.	32	21	383	28	50	5.6	840	59	4	ND	903	-
LINDSEY	11/15/84	12.5	7.5	8.6	31	23	353	28	25	4.7	570	45	2	ND	617	-
LINDSEY	12/06/84	11.	7.3	8.3	44	34	441	37	50	9.7	1000	59	2	ND	1061	-
LINDSEY	01/25/85	6.	7.4	9.2	56	46	558	12								-
LINDSEY	02/13/85	10.5	7.3	6.7	43	35	381	110	50		1200	65	3	ND	1268	-
LINDSEY	02/22/85	11.	7.4	8.6	57	39	445	65								-
LINDSEY	04/10/85	18.	7.7	8.6	61	44	531	20	15		580	86	9	ND	675	-
LINDSEY	05/08/85	17.	8.1	8.8	60	47	574	18	20		660	88	4	ND	752	-
LINDSEY	06/12/85	25.	7.9	7.1	51	45	541	28	30		900	97	6	ND	1003	-
LINDSEY	08/14/85	21.	7.8	8.6	38	32	405	48	30	8.2	750	69	5	ND	824	-
LINDSEY	09/11/85	19.5	7.7	7.5	40	37	443	30	25	9.8	820	54	4	ND	878	-
LINDSEY	10/09/85	16.5	7.6	8.1	42	41	496	31	38	17.	1500	66	3	ND	1569	-
LINDSEY	11/19/85	8.5	7.5	10.	40	37	442	18	15	7.7						-
LINDSEY	12/03/85	11.5	7.4	8.7	56	63	569	25	60	15.	1300	70	2	ND	1372	-
LINDSEY	01/16/86	10.5	7.3	6.7	65	58	458	38	80	15.	2200	56	2	ND	2258	-
LINDSEY	02/27/86	16.5	6.8	3.	21	16	208	46	60	10.	790	26	ND	ND	816	-
LINDSEY	03/13/86	13.5	7.1	6.2	23	20	221	68	100	15.	1300	47	1	ND	1348	-
LINDSEY	04/23/86	18.5	7.6	5.3	44	39	387	48	70	12.	1100	84	6	ND	1190	-
LINDSEY	05/28/86	20.	8.	6.	52	47	528	26	25	8.	380	38	5	2	425	-
LINDSEY	06/25/86	21.5	8.	7.2	43	37	461	38	20	4.4	350	36	4	1	391	-
LINDSEY	06/25/86	21.5	8.	7.2	44	38	480	38	20	8.4	270	34	8	3	315	-
LINDSEY	07/23/86	20.5	7.7	7.4	38	33	431	32	30	14.						-
LINDSEY	08/27/86	20.5	7.6	6.7	46	42	514	50	40	15.	930	65	4	ND	999	-
LINDSEY	09/09/86	18.5	7.8	7.6	42	39	466	37	40	14.	860	71	5	ND	936	-
LINDSEY	11/05/86	14.5	7.5	8.5	44	44	490	25	25	5.2	780	59	5	ND	844	-
LINDSEY	12/03/86	9.5	7.5	9.5	48	43	496	22	25	5.4	800	80	4	ND	884	-
LINDSEY	12/03/86	9.5	7.5	9.5	42	43	498	22	25	5.4	2600	110	5	ND	2715	-
LINDSEY	01/08/87	7.5	7.3	10.1	44	46	492	24	20	4.4	520	66	ND	ND	586	-

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THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> CHCl3	CHBrCl2	CHBr2Cl (ug/L)	CHBr3	TTHMFP	FLOW cfs
LINDSEY	02/05/87	10.	7.5	9.6	52	53	547	24	20	4.7	550	76	ND	ND	626	-
LINDSEY	03/03/87	11.	8.	9.9	50	52	518	37	20	6.3	1200	62	ND	ND	1262	-
LINDSEY	04/09/87	16.5	7.9	8.7	65	63	606	25	20	5.8	870	120	9	ND	999	-
LINDSEY	05/13/87	23.5	7.9	7.3	48	44	530	24	20	5.	160	85	12	ND	257	-
LINDSEY	06/04/87	19.5	7.9	7.7	53	53	593	38	25	6.2	800	67	6	ND	873	-
LINDSEY	09/03/87	21.2	7.5	6.5	42	36	461	90	25	7.2	1200	63	2	ND	1265	-
LINDSEY	09/03/87	21.2	7.5	6.5	41	36	460	90	20	7.2	1100	57	2	ND	1159	-
LINDSEY	10/08/87	20.	7.4	8.1	39	36	523	21	25	5.9	630	62	3	ND	695	-
LINDSEY	11/03/87	15.5	7.6	8.2	48	43	513	19	20	6.3	1200	63	4	ND	1267	-
LINDSEY	12/01/87	10.9	7.4	9.7	46	46	509	19	25	6.	720	47	3	ND	770	-
MALLARD	07/28/83	24.2	7.3	8.6	11	11	137	18	5	3.3	260	26	2	ND	288	-
MALLARD	08/25/83	21.	7.6	8.	21	27	216	19	15	3.4	300	65	13	ND	378	-
MALLARD	09/20/83	21.	7.3	7.7	15	16	181	13	15	3.4	410	21	3	ND	434	-
MALLARD	11/21/83	12.5	7.2	9.5	15	16	180	16	40	4.5	170	36	4	ND	210	-
MALLARD	12/28/83	10.	7.3	10.3	13	13	168	38	30	3.7	390	30	5	ND	425	-
MALLARD	02/13/85	11.5	7.7	11.9	96	155	749	12	25		220	190	130	28	568	-
MALLARD	04/10/85	16.	7.5	8.	348	569	2210	25	5		90	180	260	280	810	-
MALLARDIS	05/08/85	16.	7.8	8.7	1740	2890	9290	14	10		12	84	330	650	1076	7170.
MALLARDIS	05/29/85	17.	7.7	8.7	454	736	2720	26								8520.
MALLARDIS	06/12/85	21.5	7.8	8.	469	840	2980	19	5		65	170	340	300	875	4480.
MALLARDIS	08/14/85	19.	8.	8.5	1390	2510	8480	19	5	3.7	61	54	250	680	1045	1910.
MALLARDIS	09/11/85	18.5	7.9	8.2	1230	2180	7320	12	5	3.	21	94	370	500	985	3580.
MALLARDIS	10/09/85	17.	8.	8.4	980	1880	6330	10	5	4.5	21	140	340	520	1021	1860.
MALLARDIS	11/19/85	11.5	8.1	9.6	2340	4260	13100	9	5	3.1						4610.
MALLARDIS	12/03/85	12.	7.5	9.9	1760	3130	9970	8	8	3.4	11	72	340	640	1063	17200.
MALLARDIS	12/03/85	12.	7.5	9.9	1760	3130	9950	8	5	7.1	9	78	280	540	907	-
MALLARDIS	01/16/86	10.	7.7	10.2	2180	3540	10700	16	20	4.6	5	44	320	990	1359	8270.
MALLARDIS	02/27/86	14.5	7.	8.8	12	12	169	58	25	5.3	490	29	1	ND	520	20700.
MALLARDIS	03/13/86	13.	7.3	9.4	12	14	161	51	30	5.4	670	38	2	ND	710	245000.
MALLARDIS	04/23/86	16.5	7.3	8.9	20	23	226	22	20	3.5	440	64	8	ND	512	25400.
MALLARDIS	05/28/86	17.	7.6	8.6	680	1240	4160	26	15	7.1	39	88	260	350	737	14500.
MALLARDIS	06/25/86	21.	7.7	8.1	689	1280	4250	36	10	2.1	24	84	78	320	506	7050.
MALLARDIS	07/23/86	20.5	7.9	8.1	892	1630	5330	28	10	4.6						9480.
MALLARDIS	08/27/86	20.5	7.8	8.9	634	1140	3970	36	5	7.2	44	150	350	300	844	3910.
MALLARDIS	09/09/86	18.5	7.9	8.7	1000	1840	6180	63	5	5.9	28	130	440	690	1288	7650.
MALLARDIS	11/05/86	17.5	7.7	9.5	699	1260	4550	13	5	1.5	25	80	160	280	545	10100.
MALLARDIS	12/03/86	13.	7.5	9.7	1180	2230	7330	13	5	1.4	400	20	ND	ND	420	11400.
MALLARDIS	01/08/87	9.	7.5	10.5	1260	2310	7800	21	5	1.7	16	75	180	400	671	19915.
MALLARDIS	02/05/87	11.	7.7	10.6	972	1710	5780	18	10	2.	30	88	73	280	471	18720.
MALLARDIS	03/03/87	11.5	7.4	9.9	359	620	2280	30	15	3.3	160	250	220	270	900	6252.
MALLARDIS	04/09/87	18.	7.6	9.2	280	470	1780	45	10	3.2	230	370	340	210	1150	6225.
MALLARDIS	05/13/87	23.	8.2	5.	1240	2250	7480	20	5	2.3	26	140	290	480	936	4260.
MALLARDIS	06/04/87	20.5	7.9	8.5	1980	3640	12000	12	10	1.9	10	57	250	500	817	2897.
MALLARDIS	10/08/87	20.8	7.9	7.4	2110	3960	12200	12	10	1.7	3	19	160	450	632	3633.
MALLARDIS	11/03/87	18.8	7.8	7.8	2370	4430	13700	13	5	2.1	1	28	210	660	899	2551.
MALLARDIS	12/01/87	13.2	7.9	8.2	2880	5390	15600	22	5	1.7	ND	ND	170	790	960	4242.

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THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> $CHCl_3$ <--------------	$CHBrCl_2$	$CHBr_2Cl$ ug/L	$CHBr_3$	TTHMFP ---------->	FLOW cfs
MIDDLER	02/06/85	6.5	7.3	11.2	38	43	391	13	25	-	780	84	20	0	884	-
MIDDLER	04/05/85	17.	7.5	8.9	40	40	378	6	5	-	300	76	16	0	392	-
MIDDLER	05/01/85	19.	7.6	9.3	29	29	303	9	10	-	410	68	10	0	488	-
MIDDLER	06/05/85	20.	7.8	9.	26	25	252	17	5	-	550	67	8	0	625	-
MIDDLER	08/01/85	22.	7.4	7.8	35	46	331	12	20	3.9	660	110	26	1	797	-
MIDDLER	10/23/85	18.	7.5	9.4	40	61	396	7	10	2.2	380	120	45	2	547	-
MIDDLER	12/03/85	11.5	7.4	10.3	54	83	464	8	12	4.6	340	160	68	5	573	-
MIDDLER	03/11/86	14.5	7.3	8.2	30	38	343	24	25	6.2	530	110	12	0	652	-
MIDDLER	04/17/86	14.	7.3	8.8	20	26	213	12	25	3.5	440	60	9	0	509	-
MIDDLER	05/13/86	19.5	7.3	8.1	26	30	270	13	30	4.	480	76	11	0	567	-
MIDDLER	06/11/86	22.5	7.3	7.8	28	34	272	14	20	5.2	380	35	6	0	421	-
MIDDLER	07/09/86	23.5	7.3	7.7	24	26	263	14	15	6.7	320	52	5	0	377	-
MIDDLER	08/13/86	23.	7.3	7.3	24	27	260	16	10	5.9	-	-	-	-	-	-
MIDDLER	09/11/86	21.5	7.3	7.5	26	30	284	16	20	5.2	340	68	13	0	421	-
MIDDLER	11/19/86	14.5	7.4	9.1	20	24	230	9	15	2.4	380	41	6	0	427	-
MIDDLER	11/19/86	14.5	7.4	9.1	20	24	241	9	10	2.3	370	40	6	0	416	-
MIDDLER	01/13/87	8.5	7.3	10.	31	39	333	6	20	4.6	310	74	7	0	391	-
MIDDLER	02/10/87	11.5	7.2	9.8	36	46	384	9	20	5.3	520	78	280	0	878	-
MIDDLER	03/10/87	13.5	7.1	8.8	43	52	436	11	20	5.1	340	68	9	0	417	-
MIDDLER	04/16/87	20.	7.2	7.8	40	50	440	8	10	4.1	540	100	15	0	655	-
MIDDLER	05/20/87	21.5	7.2	6.8	25	32	293	10	10	2.4	320	61	12	0	393	-
MIDDLER	06/11/87	23.	6.9	8.9	38	52	405	10	15	3.	360	86	23	0	469	-
MIDDLER	06/11/87	23.	6.9	8.9	39	51	404	9	15	2.8	290	82	21	0	393	-
MIDDLER	09/24/87	21.6	7.3	7.1	59	84	603	10	15	3.	210	89	41	4	344	-
MIDDLER	09/24/87	21.6	7.3	7.1	59	83	603	10	10	2.7	230	86	47	4	367	-
MIDDLER	10/28/87	20.5	7.3	7.3	69	97	565	6	5	2.9	194	151	85	9	439	-
MIDDLER	11/24/87	14.5	7.2	8.5	75	118	645	5	10	3.5	290	120	66	6	482	-
MIDDLER	12/16/87	10.2	7.3	12.	68	104	581	12	25	4.7	460	130	40	3	633	-
NATOMAS	09/24/87	18.2	7.4	5.7	44	43	614	35	10	3.5	550	58	7	1	616	-
NATOMAS	10/28/87	19.5	7.3	5.5	24	26	334	56	30	7.6	940	43	5	2	990	-
NATOMAS	11/24/87	11.7	8.	6.6	58	75	454	23	10	4.6	390	70	11	1	472	-
NATOMAS	12/16/87	7.7	7.5	10.3					40	5.4	993	71	10	3	1077	-
NOBAY	07/28/83	21.	7.9	9.	10	5	301	4	5	2.7	290	15	1	ND	306	5.
NOBAY	08/25/83	19.	8.5	8.9	10	5	301	4	5	2.7	340	26	2	ND	368	5.
NOBAY	09/20/83	20.	7.6	9.7	9	5	301	2	5	3.1	350	9	ND	ND	359	5.
NOBAY	11/21/83	11.	7.8	10.4	11	7	312	11	25	3.	280	18	1	ND	299	1.
NOBAY	12/28/83	11.5	7.6	10.2	11	6	279	22	20	2.6	270	17	5	ND	292	1.
NOBAY	01/31/84	11.5	8.2	11.3	12	7	322	4	8	2.6	300	18	1	ND	319	1.
NOBAY	02/22/84	12.	8.2	10.7	12	6	314	6	8	3.1	290	18	1	ND	309	0.5
NOBAY	03/14/84	16.	8.3	8.2	13	6	333	4	5	3.	340	21	1	ND	362	0.
NOBAY	04/11/84	15.	8.4	10.4	10	6	310	4	2	2.8	290	18	1	ND	309	1.
NOBAY	05/23/84	20.	8.4	9.3	10	5	312	4	5	3.2	400	18	1	ND	419	1.5
NOBAY	06/13/84	17.5	8.5	9.5	9	5	306	1	5	2.8	400	18	1	ND	419	4.
NOBAY	07/11/84	19.5	7.5	9.1	9	5	308	4	5	2.9	340	17	1	ND	358	4.5
NOBAY	08/22/84	19.	8.4	9.2	10	5	314	8	8	2.8	340	17	1	ND	358	5.
NOBAY	09/12/84	19.5	8.4	9.	9	5	321	2	2	3.	380	20	1	ND	401	4.5

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THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential ----> $CHCl_3$	$CHBrCl_2$ ug/L	$CHBr_2Cl$	$CHBr_3$	TTHMFP	FLOW cfs
NOBAY	10/11/84	18.	8.2	9.1	9	5	312	3	5	2.5	470	20	1	ND	491	7.
NOBAY	11/15/84	13.	8.	9.4	10	6	296	4	10	2.6	310	15	1	ND	326	11.
NOBAY	12/06/84	10.5	8.1	10.1	15	10	339	12	18	3.6	400	23	1	ND	424	11.
NOBAY	02/13/85	10.5	8.	8.7	18	10	321	60	50		750	31	1	ND	782	13.
NOBAY	04/10/85	17.5	8.4	9.5	14	8	371	3	ND		260	22	2	ND	284	4.5
NOBAY	05/08/85	16.	8.1	9.8	11	5	334	4	10		300	22	1	ND	323	4.5
NOBAY	06/12/85	20.	8.2	9.2	10	5	325	4	10		320	26	1	ND	347	6.5
NOBAY	08/14/85	18.	8.3	10.1	10	5	336	2	5	3.4	250	27	1	ND	278	5.5
NOBAY	10/09/85	16.	8.3	9.7	9	5	330	1	5	3.2	310	20	2	ND	332	6.
NOBAY	12/03/85	11.5	8.	10.3	10	6	320	7	5	3.9	300	24	1	ND	325	13.
NOBAY	03/13/86	14.	8.	9.5	11	6	278	30	20	3.7	520	22	1	ND	543	3.
NOBAY	04/23/86	18.	8.2	9.1	13	7	336	7	10	2.7	320	24	2	ND	346	3.
NOBAY	05/28/86	19.5	8.3	9.6	10	5	306	7	5	3.1	300	15	1	ND	316	5.
NOBAY	05/28/86	19.5	8.3	9.6	9	5	300	6	10	7.3	120	8	3	2	133	-
NOBAY	06/25/86	19.	8.3	9.2	9	5	293	5	10	1.5	150	8	2	1	161	7.
NOBAY	07/23/86	19.	8.4	8.9	9	5	296	4	5	4.5						-
NOBAY	08/27/86	18.5	8.3	9.6	9	6	298	4	5	4.	310	17	ND	ND	327	-
NOBAY	09/09/86	18.5	8.2	9.2	8	5	286	4	5	3.8	310	17	ND	ND	327	-
NOBAY	11/05/86	13.5	8.2	9.6	10	6	299	4	10	2.2	300	13	ND	ND	313	1.5
NOBAY	12/03/86	10.5	8.2	11.2	10	5	293	3	10	1.9	770	69	3	ND	842	2.
NOBAY	01/08/87	9.	8.	11.5	8	4	301	2	15	2.	340	18	ND	ND	358	-
NOBAY	02/05/87	11.5	8.2	11.	10	6	316	3	5	2.2	320	17	ND	ND	337	-
NOBAY	03/03/87	12.	8.4	11.2	9	6	331	3	ND	2.	220	5	ND	ND	225	-
NOBAY	04/09/87	17.5	8.5	9.8	11	6	322	3	5	2.5	240	32	ND	ND	272	-
NOBAY	04/09/87	17.5	8.5	9.8	11	6	323	3	ND	2.2	210	32	3	ND	245	-
NOBAY	05/13/87	20.	8.1	9.	9	5	327	5	5	2.4	260	20	1	ND	281	-
NOBAY	06/04/87	18.	8.3	9.3	9	5	328	3	5	2.1	230	18	1	ND	249	-
NOBAY	09/03/87	18.8	7.5	9.8	10	5	309	2		2.7	270	18	ND	ND	288	-
NOBAY	10/08/87	17.1	8.4	9.6	10	7	353		5	2.3	210	20	2	ND	232	-
NOBAY	11/03/87	14.5	8.1	10.1	9	5	313	1	ND	3.	120	23	ND	ND	143	-
NOBAY	12/01/87	11.9	8.1	10.1	9	6	310	1	ND	2.7	230	14	ND	ND	244	-
ROCKSL	07/26/83	23.	7.	7.	15	16	158	16	8	3.4	310	34	5	ND	349	-
ROCKSL	08/23/83	24.5	7.2	6.9	15	14	171	17	8	2.6	440	35	4	ND	479	-
ROCKSL	09/14/83	25.	7.1	6.1	26	29	254	15	35	4.6	440	43	9	ND	492	-
ROCKSL	10/12/83	21.	7.1	7.7	17	21	177	11	20	2.8	270	39	6	6	321	-
ROCKSL	11/08/83	17.	7.2	8.4	22	23	224	10	25	3.5	260	37	7	ND	304	-
ROCKSL	12/13/83	12.	6.9	9.8	20	21	202	11	30	3.	270	36	4	ND	310	-
ROCKSL	01/24/84	10.	7.3	10.8	25	25	248	16	35	3.3	320	42	8	ND	370	-
ROCKSL	02/28/84	13.5	7.5	10.	32	35	316	11	30	3.6	340	65	12	ND	417	-
ROCKSL	03/27/84	16.5	7.5	9.8	22	24	254	17	30	3.2	370	54	8	ND	432	-
ROCKSL	04/25/84	16.5	7.3	9.6	15	14	193	14	15	3.4	310	31	4	ND	345	-
ROCKSL	05/30/84	24.	7.5	8.1	15	15	194	16	12	3.8	360	39	5	ND	404	-
ROCKSL	06/27/84	26.	7.2	6.8	16	15	189	12	30	3.5	380	39	4	ND	423	-
ROCKSL	07/25/84	24.	7.7	8.1	22	27	217	10	15	2.5	320	63	17	ND	400	-
ROCKSL	08/29/84	24.	7.4	8.2	21	26	221	5	12	2.6	310	60	16	ND	386	-
ROCKSL	09/27/84	23.	7.8	8.3	16	14	199	9	10	2.8	310	31	3	ND	344	-

TABLE G-3
THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	<---- THM Formation Potential----> $CHCl_3$	$CHBrCl_2$	$CHBr_2Cl$	$CHBr_3$	TTHMFP	FLOW cfs
											<--------------		ug/L	---------->		
ROCKSL	10/25/84	17.	8.	10.9	16	15	194	8	12	3.2	330	32	4	ND	366	-
ROCKSL	11/29/84	12.	7.4	10.5	14	13	186	10	30	3.7	580	32	2	ND	614	-
ROCKSL	12/12/84	11.	7.3	9.7	14	13	195	11	30	4.4	410	31	2	ND	443	-
ROCKSL	02/27/85	14.	7.5	10.3	21	21	258	6	25		350	45	5	ND	400	-
ROCKSL	04/24/85	18.	7.8	10.1	21	18	232	7	2		430	42	5	ND	477	-
ROCKSL	05/22/85	21.5	8.2	9.2	21	24	225	17	15		520	56	11	ND	587	-
ROCKSL	06/26/85	23.	7.6	8.	41	56	360	19	10		600	110	60	3	773	-
ROCKSL	08/28/85	23.5	7.6	8.1	81	122	630	8	10	2.8	340	160	100	19	619	-
ROCKSL	10/23/85	17.5	7.8	10.	99	158	738	7	5	2.1	210	210	140	36	596	-
ROCKSL	12/03/85	11.5	7.4	10.5	133	228	965	6	10	3.1	140	200	210	24	574	-
ROCKSL	03/04/86	17.5	7.3	6.2	32	35	342	16	35	8.4	670	67	6	ND	743	-
ROCKSL	04/09/86	17.	7.3	8.5	29	31	262	11	20	3.5	520	81	11	ND	612	-
ROCKSL	05/07/86	17.	7.2	7.4	21	23	227	13	20	7.8	510	48	5	ND	563	-
ROCKSL	06/04/86	22.5	7.3	7.6	19	21	225	21		4.	200	23	2	ND	225	-
ROCKSL	07/02/86	25.5	7.3	6.3	19	19	225	15	20	7.2	390	49	4	ND	443	-
ROCKSL	08/14/86	23.5	7.5	8.1	21	26	219	22	20	5.3						-
ROCKSL	08/14/86	23.5	7.5	8.1	21	26	220	22	5	5.5						-
ROCKSL	09/24/86	20.	7.5	8.1	49	31	285	17	5	2.9	300	62	18	ND	380	-
ROCKSL	11/12/86	14.5	7.3	9.4	13	14	180	15	5	1.8	240	14	2	ND	256	-
ROCKSL	12/17/86	10.	7.3	9.5	25	36	272	9	5	1.1	290	59	11	ND	360	-
ROCKSL	01/22/87	6.5	7.3	11.8	24	30	268	18	10	3.	480	58	7	ND	545	-
ROCKSL	02/24/87	11.	7.3	10.5	30	41	355	12	20	4.	670	83	22	ND	775	-
ROCKSL	03/24/87	13.	7.3	10.2	25	30	302	12	20	4.3	480	58	5	ND	543	-
ROCKSL	04/30/87	19.5	8.3	9.81	25	28	314	13	10	2.6	260	54	8	ND	322	-
ROCKSL	05/28/87	20.5	7.3	7.3	52	82	468	11	10	2.3	320	140	72	ND	532	-
ROCKSL	06/23/87	23.5	7.3	7.3	54	87	488	15	5		410	110	39	ND	559	-
ROCKSL	09/09/87	22.6	7.4	9.1	125	210	923	11	5	2.6	190	140	120	44	494	-
ROCKSL	10/22/87	19.	7.4	8.3	119	201	871	5	ND	2.8	110	100	120	44	374	-
ROCKSL	10/22/87	19.	7.4	8.3	119	201	872	4	ND	2.8	140	120	130	44	434	-
ROCKSL	11/05/87	17.5	7.3	8.9	73	116	617	4	5		390	91	84	34	599	-
ROCKSL	12/08/87	11.3	7.3	10.1	154	277	1140	5	15	3.1	250	190	160	53	653	-
VERNALIS	02/24/83	13.	7.5	9.6		26	264	18			190	24	4	ND	218	29100.
VERNALIS	04/27/83		7.1	9.7		11	150	12			310	20	6	5	341	36600.
VERNALIS	06/22/83	21.	7.	8.5		10	117	23			380	23	2	ND	405	24100.
VERNALIS	07/26/83	20.	7.3	7.7	29	30	288	29	5	3.5	290	54	12	ND	356	11300.
VERNALIS	08/23/83	20.	7.2	8.	23	24	247	19	5	3.	420	39	7	ND	466	9170.
VERNALIS	09/14/83	20.	7.4	8.2	15	14	158	16	10	2.8	350	21	3	ND	374	11200.
VERNALIS	10/12/83	17.5	7.1	8.5	11	11	126	12	10	2.8	270	24	3	ND	297	14500.
VERNALIS	11/08/83	15.	7.3	8.2	39	38	381	18	25	4.2	300	62	12	ND	374	9370.
VERNALIS	12/13/83	11.	7.1	10.	14	13	155	14	30	3.2	330	22	2	ND	354	22200.
VERNALIS	01/24/84	10.	7.	10.	21	19	210	14	25	3.1	340	32	4	ND	376	21400.
VERNALIS	02/28/84	12.	7.5	9.7	38	39	352	10	15	3.2	250	60	15	ND	325	9640.
VERNALIS	03/27/84	14.5	7.3	9.4	48	52	464	34	15	3.9	280	86	23	2	391	6300.
VERNALIS	04/25/84	14.	7.3	8.8	59	66	547	24	8	4.8	290	110	42	2	444	3980.
VERNALIS	05/30/84	24.5	7.9	7.3	69	80	629	75	10	6.1	380	120	56	3	559	2440.
VERNALIS	06/27/84	25.5	7.3	6.3	77	88	694	50	25	5.8	360	130	58	3	551	2050.

TABLE G-3

THM DATA REPORT

STA. NAME[1]	SAMP.DATE	TEMP[2] °C[3]	pH	DO mg/L	Na mg/L	Cl mg/L	EC uS/cm	TURB NTU	COL CU	TOC mg/L	THM Formation Potential: $CHCl_3$ ug/L	$CHBrCl_2$ ug/L	$CHBr_2Cl$ ug/L	$CHBr_3$ ug/L	TTHMFP ug/L	FLOW cfs
VERNALIS	07/25/84	23.	7.5	6.5		92	640		15	5.4	450	150	72	7	679	1840.
VERNALIS	08/29/84	24.	7.6	7.1	58	62	549	24	20	4.8	350	110	48	2	510	2520.
VERNALIS	09/27/84	20.	7.4	8.3	39	43	388	17	10	4.2	280	79	21	ND	380	3140.
VERNALIS	10/25/84	15.5	7.4	7.9	39	41	378	15	12	3.9	260	64	23	1	348	3580.
VERNALIS	11/29/84	11.5	7.1	9.2	43	44	400	10	25	4.4	380	68	15	ND	463	3440.
VERNALIS	12/12/84	11.	7.3	9.2	34	32	324	6	12	3.6	240	50	12	ND	302	4700.
VERNALIS	02/22/85	12.	7.4	6.4	75	69	598	10	20							3170.
VERNALIS	02/27/85	12.5	7.4	9.6	70	73	629	8	25		220	97	48	6	371	2640.
VERNALIS	04/24/85	17.	7.4	7.9	87	80	667	19	5		360	140	61	3	564	2520.
VERNALIS	05/22/85	20.5	7.4	7.2	84	99	756	31	10		400	160	68	12	640	1920.
VERNALIS	06/26/85	23.	7.5	7.3	81	94	717	52	10		540	160	66	7	773	1420.
VERNALIS	07/10/85	22.5	7.4	7.1	55	58	490	28	5		520	130	41	3	694	2500.
VERNALIS	08/28/85	19.5	7.7	7.4	52	60	487	18	5	3.9	410	100	34	2	546	2400.
VERNALIS	09/25/85	21.5	7.4	6.8	59	70	563	21	5	3.1	380	98	30	4	512	1600.
VERNALIS	10/23/85	15.5	7.4	7.4	53	65	519	12	5	2.4	320	110	29	2	461	1950.
VERNALIS	11/15/85	8.5	7.5	9.7	80	94	706	7	15	2.9	220	130	71	7	428	1400.
VERNALIS	11/15/85	8.5	7.5	9.7	80	94	709	7	5	4.1	240	130	71	8	449	-
VERNALIS	12/03/85	13.5	7.4	8.9	66	74	604	18	18	6.5	590	140	32	ND	762	2250.
VERNALIS	01/23/86	12.	7.5	8.8	99	107	790	18	15	3.2	930	160	76	7	1173	1750.
VERNALIS	02/13/86	11.5	7.3	9.	82	86	686	15	5	4.3	450	140	56	3	649	2200.
VERNALIS	03/04/86	15.	7.3	8.3	28	26	268	26	35	7.8	540	56	6	ND	602	15100.
VERNALIS	04/09/86	15.	7.3	9.2	18	18	169	20	25	5.3	650	47	4	ND	701	23100.
VERNALIS	05/07/86	14.5	7.3	8.8	27	27	257	17	15	6.	330	51	6	ND	387	10200.
VERNALIS	06/04/86	20.5	7.3	8.	26	28	254	22	10	4.8	220	41	6	ND	267	7850.
VERNALIS	07/02/86	23.	7.5	7.9	65	75	595	9	5	7.8	318	144	41	2	505	3180.
VERNALIS	08/14/86	21.5	7.6	7.6	60	67	557	25	5	6.3						3070.
VERNALIS	09/24/86	17.5	7.3	8.2	32	34	317		15	6.	320	85	23	ND	428	4320.
VERNALIS	11/12/86	13.5	7.3	9.7	47	55	447	10	5	2.	250	60	41	1	352	2990.
VERNALIS	12/17/86	11.5	7.3	10.5	34	37	331	10	5	1.4	160	38	9	ND	207	4250.
VERNALIS	01/22/87	8.5	7.3	11.1	73	88	679	10	5	2.5	220	85	41	4	350	2060.
VERNALIS	02/24/87	11.5	7.5	9.9	93	105	868	12	5	2.7	310	200	120	9	639	2550.
VERNALIS	03/24/87	13.	7.3	9.6	100	105	831	16	5	3.8	320	140	38	8	506	3224.
VERNALIS	04/30/87	19.	7.3	8.4	59	74	564	27	10	2.6	200	90	40	4	334	2580.
VERNALIS	05/28/87	18.	7.4	8.2	66	77	622	25	15	2.6	410	130	53	ND	593	2130.
VERNALIS	06/23/87	22.5	7.7	4.6	88	104	807	42	10		250	110	61	9	430	1890.
VERNALIS	06/24/87	23.	7.5	1.9						2.9	260	150	78	14	502	1840.
VERNALIS	08/25/87	22.1	7.4	7.7			812				370	130	63	4	567	1650.
VERNALIS	09/09/87	21.5	6.8	7.2	81	99	734	21	5	5.5	310	110	50	11	481	1800.
VERNALIS	10/22/87	18.5	7.4	8.2	91	117	807	13	ND	3.3	170	98	62	13	343	1310.
VERNALIS	11/05/87	15.	7.6	8.7	118	142	951	17	5	3.7	400	130	78	6	614	1560.
VERNALIS	12/08/87	13.6	7.4	9.4	118	146	579	12	10	2.6	170	70	39	11	290	1350.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<------------------------mg/L								-------------------->
AGDEMPIRE	02/06/85	9:05	6.	7.3	9.8	252	685	0.	2610										
AGDEMPIRE	03/06/85	9:45	10.5	7.3	7.6	226	597	0.	2330	92									
AGDEMPIRE	04/05/85	8:50	21.5	7.3	3.9	224	517		2180										
AGDEMPIRE	05/01/85	8:30	20.	7.6	6.5	248	566	0.	2280		0								
AGDEMPIRE	06/05/85	8:07	20.	7.3	4.	54	95		629										
AGDEMPIRE	07/24/85	9:07	23.	6.8	4.1	42	69		472										
AGDEMPIRE	08/01/85	8:25	22.	6.8	5.5	32	44	0.	360										
AGDEMPIRE	09/11/85	10:20	19.5	6.9	4.5	83	172		886										
AGDEMPIRE	10/02/85	7:00	18.	7.6	7.6	149	376	0.	1640										
AGDEMPIRE	11/13/85	8:00	7.	7.3	9.	170	452	0.	1880										
AGDEMPIRE	12/03/85	17:10	14.	7.	5.4	87	186		1070	76									
AGDEMPIRE	01/16/86	11:45	12.	6.8	5.8	112	228		1087										
AGDEMPIRE	02/13/86	12:00	14.	6.8	6.7	162	396		1880										
AGDEMPIRE	03/04/86	13:30	19.5	7.3	8.	233	595		2840		924	205	100	2.7	127	345	138.	0.4	1860
AGDEMPIRE	04/17/86	9:15	15.	7.4	8.8	148	357	0.	1610		418	90	47	3.3	202	62	5.3	0.3	996
AGDEMPIRE	05/13/86	10:00	21.5	7.5	6.6	204	506	0.001	2000		500	108	56	2.7	217	50	0.8	0.3	1190
AGDEMPIRE	06/11/86	8:00	22.	8.1	5.7	296	830	0.	2760		720	150	84	2.5	215	18	0.	0.4	1630
AGDEMPIRE	07/09/86	8:05	20.5	6.9	5.4	23	30		283	300									
AGDEMPIRE	08/13/86	8:00	20.5	7.1	5.1	24	37		281		84	17	10	1.8	67	17	1.8	0.1	168
AGDEMPIRE	09/11/86	7:50	20.5	7.3	5.2	192	548		2120										
AGDEMPIRE	11/19/86	10:30	16.	6.3	2.3	64	121		808		82	64	31	2.4	82	174	19.	0.5	664
AGDEMPIRE	12/10/86	11:30	12.	6.3	3.	66	128		866		297	63	34	2.7	96	131	14.	0.4	655
AGDEMPIRE	01/13/87	11:15	7.5	6.3	1.7	75	173		996		339	73	38	4.5	129	105	7.	0.3	700
AGDEMPIRE	02/10/87	10:00	11.5	6.6	3.5	132	332		1660										
AGDEMPIRE	03/10/87	10:50	13.5	6.8	3.	216	542		2390		699	148	80	2.5	142	231	18.	0.4	1530
AGDEMPIRE	04/16/87	8:30	21.5	7.5	7.2														
AGDEMPIRE	04/16/87	8:30	21.5	7.5	7.2	222	638		2510		676	152	72	2.7	192	87	1.8	0.3	1500
AGDEMPIRE	05/06/87	6:15	23.	7.9	7.5														
AGDEMPIRE	05/27/87	8:30	19.5	6.6	5.3														
AGDEMPIRE	05/27/87	8:30	19.5	6.6	5.3	32	53		408		110	24	12	1.	68	31	7.1	0.3	271
AGDEMPIRE	05/28/87	8:30	19.5	6.6	5.3														
AGDEMPIRE	06/11/87	9:30	21.	6.9	6.4	36	64		503		157	33	18	1.7	75	53	8.5	0.2	313
AGDEMPIRE	08/07/87	7:45	21.3	6.6	2.4	54	115	0.	732		247	51	29	2.5	123	71	5.4	0.4	487
AGDEMPIRE	09/24/87	8:15	19.3	7.3	3.6	274	700		2960		646	135	75	3.	198	25	0.3	0.3	1490
AGDEMPIRE	09/24/87	8:15	19.3	7.3	3.6														
AGDEMPIRE	10/19/87	7:00	16.	7.1	2.			0.											
AGDEMPIRE	10/19/87	7:00	16.	7.1	2.														
AGDEMPIRE	10/28/87	9:10	19.	7.2	2.1	122	310		1340		350	76	39	3.	149	33	0.3	0.2	977
AGDEMPIRE	10/28/87	9:10	19.	7.2	2.1														
AGDEMPIRE	11/24/87	9:30	12.5	7.2	8.1														
AGDEMPIRE	12/16/87	8:45	8.2	6.5	6.3														
AGDGRAND	02/06/85	10:30	11.5	7.1	7.5	43	35	0.	576										
AGDGRAND	03/06/85	11:00	12.5	6.9	5.3	35	29	0.	468	630									
AGDGRAND	04/05/85	10:00	18.5	7.3	5.	53	39		625										
AGDGRAND	05/01/85	9:45	18.5	6.9	5.7	23	13	0.	310										
AGDGRAND	06/05/85	9:15	21.	7.3	6.6	20	12		265										
AGDGRAND	07/24/85	7:15	22.5	7.2	5.5	22	16		267										
AGDGRAND	08/01/85	9:45	21.5	7.1	6.5	22	13	0.	273										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<------------				mg/L				------------>
AGDGRAND	09/11/85	11:50	19.5	7.2	6.1	31	33		451										
AGDGRAND	10/02/85	9:00	19.	7.2	6.	27	19	0.											
AGDGRAND	11/13/85	9:45	12.5	7.3	4.5	29	22	0.	368										
AGDGRAND	12/03/85	18:45	13.	7.	3.8	55	49	0.	735	2100									
AGDGRAND	01/16/86	13:15	13.5	7.3	7.3	64	51		716										
AGDGRAND	02/27/86	11:30	17.5	7.	4.4	35	27		602		235	46	29	4.	118	132	27.	0.4	419
AGDGRAND	03/13/86	13:00	14.5	6.6	5.8	64	57	0.001	1060										
AGDGRAND	04/23/86	12:00	18.5	7.3	7.6	32	29	0.	513										
AGDGRAND	05/28/86	11:15	22.5	7.3	7.4	21	16		323										
AGDGRAND	06/25/86	12:00	24.5	7.2	6.8	20	15		290										
AGDGRAND	07/23/86	11:15	22.5	7.1	6.	15	10	0.	210	3100	76	14	10	1.	70	19	2.6	0.2	134
AGDGRAND	08/27/86	11:45	23.5	7.2	7.6	17	11	0.	250										
AGDGRAND	09/09/86	11:00	18.5	7.1	3.	37	22	0.	378										
AGDGRAND	11/19/86	7:50	14.5	7.3	5.8	18	12		237										
AGDGRAND	12/10/86	8:00	10.	7.1	8.1	33	18		366										
AGDGRAND	01/13/87	8:05	7.	7.1	7.9	34	23	0.	458										
AGDGRAND	02/10/87	7:30	14.5	7.2	7.4	42	32		559										
AGDGRAND	03/10/87	7:45	13.	7.1	6.6	54	49	0.	852		317	53	45	1.3	223	133	15.	0.5	594
AGDGRAND	04/16/87	6:30	17.	7.	6.2														
AGDGRAND	04/16/87	6:30	17.	7.	6.2	21	17		358										
AGDGRAND	05/20/87	6:30	17.	7.3	8.2	18	12		251		90	16	12	1.6	77	26	4.	0.2	170
AGDGRAND	06/11/87	6:40	20.	7.3	6.3	33	27		398		131	21	19	1.5	130	22	4.	0.2	229
AGDGRAND	09/03/87	9:30	23.1	7.3	5.	44	41		499		175	27	26	1.	168	32	2.8	0.3	303
AGDGRAND	09/03/87	9:30	23.1	7.3	5.														
AGDGRAND	10/08/87	7:00	17.2	7.1	7.5	20	15		340		109	19	15	1.	113	12	5.7	0.2	194
AGDGRAND	10/08/87	6:30	16.5	7.3	7.2														
AGDGRAND	11/03/87	7:20	13.5	7.2	7.	31	20		441		162	27	23	1.	149	33	8.8	0.3	287
AGDGRAND	12/01/87	7:30	10.6	7.3	9.1														
AGDTYLER	03/27/85	12:45	11.5	6.8	7.8	46	84	0.	743	530									
AGDTYLER	04/24/85	12:30	19.5	7.3	5.8	56	100		743										
AGDTYLER	05/22/85	11:30	21.5	7.2	4.7	23	31	0.	320										
AGDTYLER	06/26/85	11:15	24.	6.8	5.5	15	10		188										
AGDTYLER	07/10/85	12:00	25.5	7.	4.5	14	8		189										
AGDTYLER	08/28/85	12:00	23.5	7.3	6.7	21	20	0.	299										
AGDTYLER	09/11/85	11:15	19.5	7.2	6.1	24	31		354										
AGDTYLER	10/02/85	8:00	17.5	6.9	3.2	26	18	0.	289										
AGDTYLER	11/13/85	9:00	6.	6.8	8.1	28	35	0.	376										
AGDTYLER	12/03/85	18:00	12.5	7.	3.7	36	58	0.	587	190									
AGDTYLER	01/16/86	12:45	11.	6.9	4.6	38	48		476										
AGDTYLER	06/11/86	9:15	19.5	7.3	7.9	10	9	0.	158										
AGDTYLER	07/09/86	9:30	23.5	7.3	0.5	75	114		966	410									
AGDTYLER	08/13/86	9:45	21.5	6.8	2.6	21	22		279		104	20	13	1.9	82	38	5.3	0.2	208
AGDTYLER	09/11/86	9:45	20.5	7.3	5.5	24	33		369		134	24	18	1.7	116	20	4.4	0.2	237
AGDTYLER	11/19/86	8:45	14.	7.1	4.4	55	103		804		288	46	42	2.3	234	28	8.1	0.2	527
AGDTYLER	12/10/86	8:55	9.	7.3	10.4	58	117		829		326	53	47	2.9	247	24	1.8	0.2	26
AGDTYLER	01/13/87	9:00	6.	7.1	7.6	56	109		746		282	47	40	2.5	195	37	8.8	0.2	453
AGDTYLER	02/10/87	8:30	12.5	6.9	5.5	42	73		647										
AGDTYLER	03/10/87	9:00	12.5	6.8	6.4	71	129		1100		420	71	59	1.8	171	157	49.	0.2	743

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4
MINERAL DATA REPORT

STATION	DATE	TIME	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	Se mg/L	EC uS/cm	ASBEST MF/L	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
											<-----				mg/L				----->
AGDTYLER	04/16/87	7:15	17.	7.2	6.8	16	18		310		85	16	11	1.3	81	19	3.8	0.1	184
AGDTYLER	05/20/87	7:15	16.5	7.4	7.2	18	14		249		92	17	12	1.6	91	16	1.2	0.2	183
AGDTYLER	06/11/87	7:45	21.	7.3	6.4	12	9		198		66	13	8	1.7	67	12	2.8	0.1	133
AGDTYLER	06/24/87	7:00	22.5	6.8	5.6														
AMERICAN	07/21/83	9:45	17.	7.3	10.	2	1		35										
AMERICAN	08/18/83	14:00	19.	7.3	10.1	2	1		36										
AMERICAN	09/13/83	10:00	19.5	7.2	9.2	2	1		39										
AMERICAN	10/04/83	12:15	20.	7.1	9.1	2	1		42	110									
AMERICAN	11/01/83	12:05	17.	7.1	9.	2	1		40	110									
AMERICAN	12/06/83	10:25	11.	7.2	11.8	2	1		46	1100									
AMERICAN	01/10/84	11:30	9.	7.	11.9	2	1		50	2200									
AMERICAN	02/01/84	12:20	9.5	7.1	11.9	2	2		53	490									
AMERICAN	03/07/84	10:30	9.5	7.3	11.6	2	1		57	260									
AMERICAN	04/04/84	10:35	11.	7.1	11.4	2	1		55	190									
AMERICAN	05/02/84	8:10	12.5	7.1	11.7	2	1		54	18									
AMERICAN	06/06/84	10:45	15.	7.3	10.3	2	2		52	12									
AMERICAN	07/10/84	9:50	18.	7.3	9.4	2	1		48	18									
AMERICAN	08/01/84	10:50	19.5	7.2	9.1	2	1		46										
AMERICAN	09/05/84	9:15	22.	7.2	8.6	2	1		51										
AMERICAN	10/04/84	11:30	19.5	7.1	9.1	2	1		42										
AMERICAN	11/08/84	11:20	16.	7.	9.3	2	2		51										
AMERICAN	12/05/84	11:20	11.	7.3	11.2	2	2		59	110									
AMERICAN	02/13/85	13:20	10.	7.3	11.9	2	2		63										
AMERICAN	03/13/85	12:15	12.	7.3	11.2	2	2		63	82									
AMERICAN	04/10/85	11:30	14.5	7.3	10.5	3	2		67										
AMERICAN	05/08/85	11:20	14.	7.3	10.7	3	2	0.	62										
AMERICAN	06/12/85	12:00	18.5	7.3	9.9	2	2		60										
AMERICAN	08/14/85	11:15	20.	7.2	9.1	2	2		56										
AMERICAN	10/09/85	11:30	16.5	7.2	9.2	2	2	0.	52										
AMERICAN	12/03/85	20:30	12.5	7.2	10.5	3	2		64	70									
AMERICAN	03/11/86	13:15	12.	7.1	12.	2	1		56										
AMERICAN	04/17/86	11:30	14.5	7.3	11.2	2	1	0.	55										
AMERICAN	05/13/86	11:45	16.5	7.3	10.	2	2	0.	53										
AMERICAN	06/11/86	11:30	16.5	7.3	10.	2	2	0.	46										
AMERICAN	07/09/86	11:50	17.5	7.1	9.7	2	2		46	27									
AMERICAN	08/13/86	13:30	20.5	7.2	9.3	2	1		50										
AMERICAN	09/11/86	11:30	22.	7.3	8.5	2	2		52										
AMERICAN	11/05/86	6:30	16.	6.9	10.2	2	1		46										
AMERICAN	12/03/86	6:45	12.5	7.3	9.2	2	2		51										
AMERICAN	01/08/87	6:50	9.	7.1	12.	2	1		64										
AMERICAN	02/05/87	6:30	10.	6.9	11.2	2	2		70			7	2	0.8					
AMERICAN	03/03/87	6:45	11.	7.5	11.3	2	2		69										
AMERICAN	04/09/87	5:30	16.	7.2	9.2	3	2		69										
AMERICAN	05/13/87	5:15	19.5	7.2	8.5	2	2		80										
AMERICAN	06/04/87	5:15	18.	7.3	9.4	3	2		85										
AMERICAN	09/24/87	5:45	17.	6.8	8.3														
AMERICAN	09/24/87	5:45	17.	6.8	8.3	2	2		78										
AMERICAN	10/28/87	6:30	20.	7.1	8.2	4	3		73										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

			TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
STATION	DATE	TIME	oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<------------------------mg/L------------------->								
AMERICAN	10/28/87	6:30	20.	7.1	8.2														
AMERICAN	11/24/87	6:30	10.5	8.	9.5														
AMERICAN	12/16/87	10:00	11.	7.1	9.3														
BANKS	07/26/83	10:00	23.	7.3	8.3	21	22		211										
BANKS	08/23/83	8:30	22.5	7.3	8.	25	28		261										
BANKS	09/14/83	8:50	22.	7.3	7.	22	24		226										
BANKS	10/12/83	7:55	20.5	7.3	7.6	23	26		219	860									
BANKS	11/08/83	8:50	16.5	7.2	8.6	19	20		186										
BANKS	12/13/83	9:40	12.	7.3	10.2	32	34		305	820									
BANKS	01/24/84	8:50	9.5	7.3	11.2	26	28		252	490									
BANKS	02/28/84	9:40	12.	7.5	10.	42	46		388										
BANKS	03/27/84	8:40	16.5	7.3	9.8	36	40		370										
BANKS	04/25/84	9:15	15.	7.3	9.3	27	30		283										
BANKS	05/30/84	7:25	23.	7.5	7.1	29	33		304										
BANKS	06/27/84	8:20	24.5	7.3	6.6	24	34		258										
BANKS	07/25/84	8:30	23.	7.4	8.1	20	23		214										
BANKS	08/29/84	7:15	23.	7.3	7.4	22	24		244										
BANKS	09/27/84	9:25	22.5	7.3	8.6	25	25	0.	268										
BANKS	10/25/84	9:20	16.5	7.7	9.3	25	26	0.	266										
BANKS	11/29/84	11:30	11.5	7.5	10.5	20	21	0.	233										
BANKS	12/12/84	9:45	11.5	7.3	10.	23	24		263										
BANKS	02/27/85	9:45	13.5	7.5	9.5	30	33	0.	335										
BANKS	03/27/85	9:00	12.5	7.4	10.1	36	38	0.	367	520									
BANKS	04/24/85	9:15	17.5	7.6	8.7	36	34		351										
BANKS	05/22/85	8:15	19.5	8.1	8.6	35	41	0.	351										
BANKS	06/07/85	8:50	23.5	7.5	7.4	32	37		322										
BANKS	06/26/85	8:00	23.5	7.7	7.5	38	46		370										
BANKS	07/10/85	8:00	24.5	7.5	7.5	42	48	0.	343										
BANKS	08/28/85	8:30	22.5	7.4	7.8	54	78	0.	466										
BANKS	09/25/85	8:20	22.5	7.5	7.9	69	102	0.	588										
BANKS	10/23/85	8:00	17.	7.6	8.9	59	94	0.	527										
BANKS	11/15/85	9:30	12.	7.4	9.5	71	112	0.	586										
BANKS	12/03/85	14:15	11.5	7.4	10.1	85	141	0.	676	230									
BANKS	01/23/86	9:20	12.	7.3	9.2	56	79	0.	482										
BANKS	02/13/86	8:45	11.5	7.7	10.5	45	61	0.	444										
BANKS	03/04/86	9:30	16.5	7.3	8.2	30	33	0.	332										
BANKS	04/09/86	9:15	17.5	7.5	9.4	29	31	0.	265										
BANKS	05/07/86	7:45	15.5	7.3	8.9	28	31		284										
BANKS	06/04/86	8:15	19.5	7.5	8.6	31	38	0.001	312										
BANKS	07/02/86	8:05	24.	7.3	6.4	31	33	0.	305	780	77	16	9	2.3	59	34	1.6	0.2	231
BANKS	08/14/86	8:45	24.	7.3	7.7	27	32	0.001	280										
BANKS	09/24/86	8:30	19.5	7.5	8.6	10	34	0.	297										
BANKS	11/12/86	9:30	14.	7.4	9.7	20	23	0.	236										
BANKS	12/17/86	10:00	10.	7.3	10.1	32	31	0.	278										
BANKS	01/22/87	9:45	6.5	7.3	12.	28	34	0.003	309										
BANKS	02/24/87	9:45	11.5	7.3	10.7	41	55	0.	446										
BANKS	03/24/87	9:30	13.	7.5	9.7	57	69	0.001	568										
BANKS	04/30/87	8:40	18.5	8.4	10.	34	38	0.	396										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<------				mg/L				------>
BANKS	05/28/87	10:30	18.	7.4	11.	39	52	0.	397										
BANKS	06/23/87	10:30	22.5	7.6	8.3	51	75	0.	487										
BANKS	08/17/87	11:15	21.9	7.4	7.6	85	130	0.002	639		119	18.	18	2.	74	33	2.6	0.2	359
BANKS	09/09/87	8:45	22.	7.2	8.	77	124		628										
BANKS	09/09/87	8:45	21.5	7.2	7.4														
BANKS	10/22/87	8:00	19.5	7.4	7.9	116	173		814										
BANKS	10/22/87	8:00	19.5	7.4	7.9														
BANKS	11/05/87	9:00	17.5	7.4	8.7	91	143		703										
BANKS	12/08/87	9:00	12.6	7.4	9.8	113	180		835										
BARKER	09/03/87	0:00																	
BARKER	09/03/87	8:00	20.5	7.3	5.5	33	23		734										
BARKER	10/08/87	10:40	19.8	7.4	7.6	39	28		561										
BARKER	10/08/87	10:40	19.8	7.4	7.6														
BARKER	11/03/87	8:50	14.5	7.3	7.1	49	35		561										
BARKER	12/01/87	9:15	11.3	7.5	10.2	54	46		599										
CACHE	01/31/84	10:45	11.5	8.3	12.4	85	88		976	980									
CACHE	02/22/84	10:55	12.5	8.1	10.4	82	82		896	2500									
CACHE	03/14/84	10:30	16.5	8.1	8.4	79	80		897	650									
CACHE	04/11/84	10:05	15.5	8.6	10.1	59	57		720	1700									
CACHE	05/23/84	10:45	21.	8.3	9.	36	34		488	1100									
CACHE	06/13/84	8:15	19.	8.2	8.5	42	42		595	4000									
CACHE	07/11/84	9:00	24.5	8.3	8.5	36	34		541	1400									
CACHE	08/22/84	10:40	21.5	8.1	7.5	32	29		495										
CACHE	09/12/84	11:00	23.	8.1	8.9	39	38	0.001	577										
CACHE	10/11/84	9:30	19.5	8.2	7.8	44	42		594										
CACHE	11/15/84	10:00	12.5	7.4	7.7	38	38	0.	460										
CACHE	12/06/84	9:50	10.5	7.9	8.8	64	64	0.001	744	3200									
CACHE	04/10/85	9:35	16.	8.3	9.5	63	62	0.001	713										
CACHE	05/08/85	9:35	16.5	8.4	9.4	44	38	0.001	560										
CACHE	05/29/85	10:15	17.5	8.4	9.5	36	33		512										
CACHE	06/12/85	10:00	24.	8.1	7.1	35	33	0.001	499										
CLIFTON	07/26/83	11:35	21.	7.3	7.9	20	22		208										
CLIFTON	08/23/83	10:00	21.5	7.3	7.7	27	31		283										
CLIFTON	09/14/83	10:35	22.5	7.3	7.8	17	17		180										
CLIFTON	10/12/83	9:10	20.	7.1	8.3	12	13		137	530									
CLIFTON	11/08/83	9:45	16.	7.3	8.5	33	36		324	910									
CLIFTON	12/13/83	11:10	12.	7.1	9.6	16	16		171	510									
CLIFTON	01/24/84	9:40	10.	7.3	10.8	22	22		226	510									
CLIFTON	02/28/84	11:05	13.	7.5	10.2	39	42		389	410									
CLIFTON	03/27/84	9:45	16.5	7.4	9.4	35	40		362	480									
CLIFTON	04/25/84	10:40	16.5	7.3	9.3	27	30		288	890									
CLIFTON	05/30/84	8:20	24.	7.1	7.4	29	33		307	650									
CLIFTON	06/27/84	9:45	25.5	7.2	6.3	50	56		472	500									
CLIFTON	07/25/84	9:40	24.	7.5	8.6	18	21	0.	212	960									
CLIFTON	08/29/84	8:15	24.5	7.3	7.6	20	23		222										
CLIFTON	09/27/84	10:40	22.	7.5	8.3	24	24	0.	261										
CLIFTON	10/25/84	10:45	17.	7.5	10.	27	29		284										
CLIFTON	11/29/84	12:45	12.	7.3	10.2	20	21		233										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	Se mg/L	EC uS/cm	ASBEST MF/L	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
											<------				mg/L				------>
CLIFTON	12/12/84	10:55	11.5	7.3	10.	21	22	0.	252	420									
CLIFTON	01/30/85	9:25	7.	7.1	10.5	32	37	0.	348										
CLIFTON	02/27/85	11:00	13.	7.3	9.8	26	28	0.	303										
CLIFTON	03/27/85	10:30	12.5	7.4	9.6	33	34	0.	334	670									
CLIFTON	04/24/85	10:30	18.	7.6	9.6	24	24	0.	277										
CLIFTON	05/22/85	9:30	21.5	8.1	9.2	25	29	0.	264										
CLIFTON	06/26/85	9:15	24.5	7.5	7.7	37	40	0.	314										
CLIFTON	07/10/85	9:00	25.5	7.5	6.5	43	50	0.001	386										
CLIFTON	08/28/85	10:00	23.5	7.4	7.7	51	69	0.	458										
CLIFTON	09/25/85	9:40	22.5	7.4	6.6	64	80	0.	602										
CLIFTON	10/23/85	9:15	17.5	7.5	8.9	52	77	0.	484										
CLIFTON	11/15/85	10:45	12.	7.4	10.2	92	143	0.	679										
CLIFTON	12/03/85	13:05	12.	7.4	10.1	98	162	0.	744	230									
CLIFTON	01/23/86	10:45	11.5	7.3	9.	48	60	0.	410										
CLIFTON	02/13/86	9:50	11.5	7.3	10.4	41	55	0.	423										
CLIFTON	03/04/86	10:45	16.5	7.3	7.8	29	29	0.001	306		66	15	7	2.1	50	41	3.1	0.2	177
CLIFTON	04/09/86	11:00	16.5	7.2	8.8	20	20	0.	197		48	11	5	1.5	39	24	1.2	0.2	121
CLIFTON	05/07/86	8:50	15.5	7.3	8.8	27	28	0.001	280		69	16	7	1.8	55	36	3.2	0.2	171
CLIFTON	06/04/86	9:45	20.5	7.3	8.2	29	33	0.001	303		73	16	8	1.7	52	39	3.8	0.2	177
CLIFTON	07/02/86	9:20	24.5	7.3	6.5	55	66		534	600									
CLIFTON	08/14/86	10:45	24.5	7.4	7.4	61	71		571										
CLIFTON	09/24/86	9:45	19.5	7.3	8.3	27	33		292										
CLIFTON	11/12/86	10:30	14.	7.3	9.7	24	29		276										
CLIFTON	12/17/86	8:40	10.	7.3	10.	32	32		285										
CLIFTON	01/22/87	8:30	6.5	7.3	11.5	26	32		300										
CLIFTON	02/24/87	8:45	11.5	7.3	10.1	38	51		435										
CLIFTON	03/24/87	8:30	13.5	7.3	9.6	77	91		730										
CLIFTON	04/30/87	7:30	20.	8.3	11.1	29	32		365										
CLIFTON	05/28/87	8:45	19.5	7.4	9.	39	58		401										
CLIFTON	06/23/87	8:45	23.	8.3	7.4	49	70		483										
CLIFTON	09/09/87	9:45	22.4	7.4	8.1	79	133		646										
CLIFTON	09/09/87	9:45	22.4	7.4	8.1														
CLIFTON	10/22/87	8:45	19.5	7.4	7.3	95	165		777										
CLIFTON	10/22/87	8:45	19.5	7.4	7.3														
CLIFTON	11/05/87	11:30	18.	7.3	7.6	113	190		821										
CLIFTON	12/08/87	10:00	11.3	7.4	10.2	108	182		847										
COSUMNES	07/21/83	8:30	22.5	7.3	8.5	3	2		67										
COSUMNES	08/18/83	12:55	28.	7.7	8.3	4	2		85										
COSUMNES	09/13/83	9:00	25.	7.3	7.8	4	2		90										
COSUMNES	10/04/83	11:05	21.5	7.3	8.9	4	2		80	140									
COSUMNES	11/01/83	11:10	18.	7.3	9.3	4	2		82	180									
COSUMNES	12/06/83	9:35	8.5	7.2	12.	7	2		81	230									
COSUMNES	01/10/84	10:30	8.	7.2	11.8	3	2		78	300									
COSUMNES	02/01/84	11:15	9.5	7.	11.5	4	2		93	18									
COSUMNES	03/07/84	9:35	11.5	7.3	11.4	4	2		86	91									
COSUMNES	04/04/84	9:40	14.	7.1	10.7	3	2		80	95									
COSUMNES	05/02/84	7:20	14.	7.3	10.6	4	1		76	25									
COSUMNES	06/06/84	9:50	19.	7.3	9.1	3	2		74	33									

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4
MINERAL DATA REPORT

STATION	DATE	TIME	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	Se mg/L	EC uS/cm	ASBEST MF/L	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
											<---				mg/L				--->
COSUMNES	07/10/84	9:00	27.5	7.7	7.6	4	2		86	10									
COSUMNES	08/01/84	10:03	27.	7.6	8.1	4	2		93										
COSUMNES	09/05/84	8:20	25.5	7.3	7.1	4	2		96										
COSUMNES	10/04/84	10:25	21.	7.4	9.	4	2		90										
COSUMNES	11/08/84	10:15	13.5	7.2	10.2	4	2		82										
COSUMNES	12/05/84	10:40	10.5	7.3	11.3	5	4		129	9									
DMC	07/26/83	10:45	23.	7.3	7.5	33	38		322										
DMC	08/23/83	9:05	21.5	7.3	7.7	28	31		283										
DMC	09/14/83	9:40	21.	7.3	7.8	18	18		188										
DMC	10/12/83	8:35	18.5	7.3	8.5	14	15		151	760									
DMC	11/08/83	9:15	16.5	7.2	8.2	37	39		361	1100									
DMC	12/13/83	10:35	12.	7.2	9.5	23	26		238	570									
DMC	01/24/84	9:15	10.5	7.3	10.7	30	33		297	1600									
DMC	02/28/84	10:25	12.5	7.5	10.	42	48		397	370									
DMC	03/27/84	9:15	16.	7.3	9.5	53	60		511	700									
DMC	04/25/84	9:55	15.5	7.5	9.3	60	68		552	1800									
DMC	05/30/84	7:50	23.5	7.4	7.6	29	33		298	380									
DMC	06/27/84	9:05	25.5	7.3	6.	32	35		328	730									
DMC	07/25/84	9:10	24.	7.7	7.4	58	73		554	1100									
DMC	08/29/84	7:40	24.5	7.3	7.3	21	22		229										
DMC	09/27/84	10:05	22.	7.4	8.2	28	29	0.	296										
DMC	10/25/84	10:00	16.	7.8	9.8	25	26	0.	268										
DMC	11/29/84	12:15	11.	7.4	10.2	32	34	0.	321										
DMC	12/12/84	10:15	11.5	7.2	9.3	31	32	0.	315	590									
DMC	01/30/85	8:50	7.5	7.3	10.6	38	44	0.001	398										
DMC	02/27/85	10:15	13.	7.5	9.9	31	34	0.	336										
DMC	03/27/85	9:45	12.	7.4	9.8	29	31	0.	315	980									
DMC	04/24/85	10:00	17.5	7.5	9.5	25	24	0.	280										
DMC	05/22/85	9:00	20.5	8.3	9.1	25	29	0.	265										
DMC	06/26/85	8:30	24.5	7.6	7.1	78	95	0.001	710										
DMC	07/10/85	8:30	24.5	7.4	6.7	59	68	0.001	544										
DMC	08/28/85	9:20	23.	7.4	7.7	50	74	0.	441										
DMC	09/25/85	9:15	22.5	7.5	6.8	66	85	0.001	593										
DMC	10/23/85	8:40	16.5	7.4	7.2	60	79	0.	592										
DMC	11/15/85	10:15	12.	7.4	10.5	68	106	0.	545										
DMC	12/03/85	13:05	12.	7.4	10.1	72	117	0.	591	370									
DMC	01/23/86	10:00	11.5	7.3	8.8	52	63	0.	439										
DMC	02/13/86	9:15	11.5	7.5	10.2	44	60	0.	460										
DMC	03/04/86	10:15	16.5	7.3	7.9	29	28	0.001	288										
DMC	04/09/86	9:45	16.	7.3	9.	23	27	0.	229										
DMC	05/07/86	8:15	16.	7.2	8.3	27	28		278										
DMC	06/04/86	9:00	21.5	7.3	7.7	36	48	0.	362										
DMC	07/02/86	8:45	24.5	7.3	7.	54	62	0.001	530	660	128	28	14	2.6	78	65	5.2	0.3	338
DMC	08/14/86	9:30	24.5	7.3	6.6	63	73	0.002	586										
DMC	09/24/86	9:10	18.5	7.3	8.1	32	35	0.	320										
DMC	11/12/86	10:00	13.5	7.4	9.4	58	71	0.001	545										
DMC	12/17/86	9:15	10.	7.2	9.6	35	34	0.	299										
DMC	01/22/87	9:00	6.5	7.3	11.5	33	40	0.001	356										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<----------				mg/L				---------->
DMC	02/24/87	9:15	10.5	7.3	9.7	88	102	0.002	860										
DMC	03/24/87	8:45	13.	7.5	9.6	88	104	0.003	804										
DMC	04/30/87	8:00	20.	8.3	10.3	29	32	0.	359										
DMC	05/28/87	8:30	18.5	7.5	8.6	39	57	0.	405										
DMC	06/23/87	8:15	23.	7.5	7.5	49	70	0.	466										
DMC	09/09/87	9:20	22.	7.4	7.7	59	90		503										
DMC	09/09/87	9:20	22.	7.4	7.7														
DMC	10/22/87	8:30	19.	7.4	7.2														
DMC	10/22/87	8:30	19.	7.4	7.2	89	155		751										
DMC	11/05/87	10:00	18.	7.3	8.5	77	116		620										
DMC	12/08/87	9:45	11.3	7.3	10.2	113	181		847										
DVGH	08/10/83	11:45	12.5	7.8	3.9	14	11		395										
DVGH	08/10/83	12:00	23.5	8.5	8.4	19	16		466										
DVSR	09/20/83	7:20	14.5	7.3	5.3	15	12		414										
DVSR	10/18/83	11:50	18.	8.	7.	17	13		430	54									
DVSR	11/21/83	11:50	15.5	7.9	8.4	18	15		469	310									
DVSR	03/11/86	8:45	13.	8.1	11.3	14	12	0.	322										
DVSR	05/13/86	7:00	16.	8.2	6.4	15	11	0.	356										
GREENES	07/21/83	6:00	19.5	7.3	8.7	7	4		115										
GREENES	08/18/83	6:45	21.	7.5	8.2	7	4		124										
GREENES	09/13/83	6:40	20.5	7.3	8.3	10	6		154										
GREENES	10/04/83	9:25	18.	7.3	9.	7	5		124	380									
GREENES	11/01/83	6:50	17.	7.3	9.1	8	5		128	340									
GREENES	12/06/83	6:35	10.5	7.4	10.6	4	4		122	2200									
GREENES	01/10/84	8:15	9.	7.3	10.7	7	4		129	3200									
GREENES	02/01/84	9:50	10.	7.1	10.8	7	5		140	740									
GREENES	03/07/84	7:35	12.	7.5	10.8	10	7		164	540									
GREENES	04/04/84	6:35	13.5	7.5	10.4	9	6		148	680									
GREENES	05/02/84	5:30	16.	7.3	9.4	10	6		154	110									
GREENES	06/06/84	6:25	18.	7.5	8.7	10	7		146	200									
GREENES	07/10/84	6:50	22.5	7.4	8.2	7	4		121	150									
GREENES	08/01/84	6:00	21.5	7.4	7.9	8	4		133										
GREENES	08/21/84	10:40	23.	7.3	8.2	11	6		164										
GREENES	09/05/84	6:05	22.	7.4	7.7	12	6	0.	185										
GREENES	10/04/84	6:20	17.5	7.4	9.	8	4	0.	132										
GREENES	11/08/84	8:20	14.	7.3	9.7	10	6	0.	154										
GREENES	12/05/84	7:45	10.5	7.4	10.9	9	6	0.	160	1100									
GREENES	01/30/85	11:45	9.	7.4	11.9	12	7	0.	186										
GREENES	02/06/85	11:30	8.	7.5	12.1	11	6	0.	174										
GREENES	03/06/85	12:00	11.	7.4	10.5	11	7	0.	180	180									
GREENES	04/05/85	10:35	19.	7.4	9.3	13	6	0.	176										
GREENES	05/01/85	10:30	19.	7.3	8.8	11	7	0.001	167										
GREENES	05/29/85	5:10	18.	7.4	9.5	13	7		178										
GREENES	06/05/85	9:55	21.	7.4	8.5	13	6	0.	173										
GREENES	07/24/85	8:00	22.5	7.3	8.	11	5	0.	163										
GREENES	08/01/85	10:35	22.5	7.5	7.9	11	5	0.	163										
GREENES	09/04/85	9:30	22.	7.3	7.8	15	8	0.001	207										
GREENES	10/02/85	10:15	21.5	7.5	8.2	14	8	0.	168										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	Se mg/L	EC uS/cm	ASBEST MF/L	HARD <---	Ca	Mg	K	ALK -mg/L-	SO4	NO3	B	TDS --->
GREENES	11/13/85	10:40	12.	7.3	9.7	11	7	0.	163										
GREENES	12/03/85	19:30	11.5	7.3	9.3	10	7	0.	149	380									
GREENES	01/16/86	14:00	10.	7.3	10.6	18	10	0.	218										
GREENES	02/27/86	12:40	12.5	7.1	10.5	4	2	0.	84										
GREENES	03/13/86	13:45	11.5	7.3	11.	3	2	0.	70		28	6	3	0.8	30	4	0.9	0.	49
GREENES	04/23/86	12:45	18.5	7.3	8.5	10	7	0.	179		66	13	8	1.2	64	12	3.1	0.	114
GREENES	05/28/86	12:00	23.5	7.3	7.5	12	9	0.	188		66	13	8	1.4	65	14	2.1	0.	109
GREENES	06/25/86	12:50	24.5	7.3	7.8	11	8	0.	161		56	11	7	1.2	52	11	1.5	0.1	106
GREENES	07/23/86	12:15	22.5	7.3	7.8	8	5		128	910									
GREENES	08/27/86	12:45	24.5	7.6	7.3	12	7		179										
GREENES	09/09/86	11:55	22.5	7.3	7.7	13	7		182										
GREENES	11/19/86	7:00	14.5	7.3	10.	8	6		146		50	10	6	1.4	52	9	2.3	0.	92
GREENES	12/10/86	7:10	11.	7.3	10.7	11	6		152		59	12	7	1.9	60	7	3.5	0.1	100
GREENES	01/13/87	7:15	7.5	7.3	11.	11	7		178		59	12	7	1.8	68	11	2.	0.1	109
GREENES	02/10/87	6:45	12.	7.3	9.4	14	10		193		66	13	8	1.6	72	15	1.	0.1	124
GREENES	03/10/87	6:45	13.5	7.1	8.4	7	5		128		43	9	5	1.4	50	6	2.3	0.1	88
GREENES	04/16/87	5:45	16.5	7.2	5.6	10	7		178		59	12	7	1.3	66	9	2.2	0.1	114
GREENES	05/20/87	5:45	20.	7.4	7.7														
GREENES	05/20/87	5:45	20.	7.4	7.7	12	7		172		63	12	8	1.	61	10	2.1	0.1	113
GREENES	06/11/87	5:50	21.	7.3	7.6	11	7		176		59	12	7	1.3	63	8	1.8	0.1	102
GREENES	08/25/87	0:00																	
GREENES	08/26/87	0:00																	
GREENES	09/03/87	10:15	23.7	7.1	9.														
GREENES	09/03/87	10:15	23.7	7.1	9.	14	11		204		68	14	8	1.	71	12	3.2		128
GREENES	10/08/87	5:35	20.	7.2	8.7	9	5		159		50	10	6	1.	58	7	1.7		87
GREENES	10/08/87	5:35	20.	7.2	8.7														
GREENES	11/03/87	6:40	16.5	7.1	8.1	12	9		180		63	12	8	1.	66	10	0.8		106
HONKER	08/17/83	10:00	24.5	7.3	7.1	8	8		126										
HONKER	10/04/83	7:00	20.5	7.3	8.	7	7		114	190									
HONKER	12/06/83	8:20	10.	7.2	10.	17	26		232	620									
HONKER	02/01/84	7:55	10.	7.1	9.7	27	32		302	380									
HONKER	04/04/84	8:15	15.	7.3	9.6	12	14		171	500									
HONKER	06/06/84	7:40	19.	7.5	7.6	13	12		178	260									
HONKER	08/01/84	7:02	23.	7.3	7.2	11	12		166										
HONKER	10/04/84	7:50	18.5	7.3	8.8	7	5		120										
HONKER	12/05/84	8:50	10.5	7.2	9.8	12	15		184	770									
LCONNECT	09/24/87	8:30	20.5	7.4	7.9	17	13		270										
LCONNECT	10/28/87	8:50	20.5	7.3	7.	21	28		242										
LCONNECT	12/11/87	8:30	8.2	7.3	11.3														
LCONNECTSL	02/06/85	8:45	7.	7.4	11.2	20	22		252										
LCONNECTSL	03/06/85	9:15	11.	7.4	10.	14	18		218	140									
LCONNECTSL	04/05/85	8:15	17.5	7.3	9.5	13	11		188										
LCONNECTSL	05/01/85	8:00	19.	7.4	9.1	13	11	0.	175										
LCONNECTSL	06/05/85	7:45	20.5	7.5	8.7	13	10		180										
LCONNECTSL	06/07/85	7:00	23.	7.7	8.7	13	9		178										
LCONNECTSL	08/01/85	8:00	22.5	7.4	8.	13	10		186										
LCONNECTSL	10/02/85	6:40	20.	7.5	7.8	18	11		209										
LCONNECTSL	11/13/85	7:30	11.5	7.3	9.	12	11		183										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<------------------------mg/L-------------------->								
LCONNECTSL	12/03/85	16:45	11.5	7.3	10.2	15	15		204	68									
LCONNECTSL	03/11/86	11:45	14.5	7.3	9.	12	19		192										
LCONNECTSL	04/17/86	9:45	15.5	7.2	8.5	17	20	0.001	195										
LCONNECTSL	05/13/86	9:45	19.5	7.3	8.4	12	15		162										
LCONNECTSL	06/11/86	7:45	21.5	7.3	7.9	9	8		136										
LCONNECTSL	07/09/86	7:15	23.	7.3	7.7	10	10		154	220									
LCONNECTSL	08/13/86	7:35	21.5	7.3	7.8	10	10		153										
LCONNECTSL	09/11/86	7:30	21.5	7.4	7.6	12	10		181										
LCONNECTSL	11/19/86	10:00	13.5	7.2	9.1	9	9		156										
LCONNECTSL	12/10/86	11:00	11.	7.3	10.	12	9		168										
LCONNECTSL	01/13/87	10:30	7.5	7.1	10.1	13	18		209										
LCONNECTSL	02/10/87	10:30	11.5	7.2	9.6	16	21		235										
LCONNECTSL	03/10/87	10:30	13.5	7.1	9.1	16	25		261										
LCONNECTSL	04/16/87	9:15	19.5	7.2	6.8	13	16		228										
LCONNECTSL	05/20/87	8:30	21.5	7.4	8.5	13	12		194										
LCONNECTSL	06/11/87	9:15	22.5	7.8	8.	17	18		241										
LCONNECTSL	09/24/87	8:30	20.5	7.4	7.9														
LCONNECTSL	10/28/87	8:50	20.	7.2	7.4														
LINDSEY	07/11/84	9:40	24.5	8.4	6.7	37	29		426	2700									
LINDSEY	08/22/84	11:05	21.5	8.	7.6	35	26		411										
LINDSEY	09/12/84	11:55	22.5	7.6	7.	34	25	0.	424										
LINDSEY	10/11/84	9:50	19.5	7.8	8.	32	21		383										
LINDSEY	11/15/84	10:45	12.5	7.5	8.6	31	23	0.	353										
LINDSEY	12/06/84	10:50	11.	7.3	8.3	44	34	0.	441	3500									
LINDSEY	01/25/85	10:45	6.	7.4	9.2	56	46	0.	558										
LINDSEY	02/13/85	11:50	10.5	7.3	6.7	43	35	0.	381										
LINDSEY	02/22/85	10:30	11.	7.4	8.6	57	39	0.	445										
LINDSEY	03/13/85	11:45	12.5	7.6	9.1	51	41	0.	482	7500									
LINDSEY	04/10/85	10:15	18.	7.7	8.6	61	44	0.	531										
LINDSEY	05/08/85	10:00	17.	8.1	8.8	60	47	0.	574										
LINDSEY	05/29/85	10:30	20.	7.9	8.6	55	47		571										
LINDSEY	06/12/85	10:45	25.	7.9	7.1	51	45	0.	541										
LINDSEY	07/24/85	6:10	22.	7.6	7.	40	33	0.	421										
LINDSEY	08/14/85	9:55	21.	7.8	8.6	38	32	0.	405										
LINDSEY	09/11/85	9:00	19.5	7.7	7.5	40	37	0.	443										
LINDSEY	10/09/85	10:05	16.5	7.6	8.1	42	41	0.	496										
LINDSEY	11/19/85	8:20	8.5	7.5	10.	40	37	0.	442										
LINDSEY	12/03/85	7:20	11.5	7.4	8.7	56	63	0.	569	1160									
LINDSEY	01/16/86	7:45	10.5	7.3	6.7	65	58	0.	458										
LINDSEY	02/27/86	7:50	16.5	6.8	3.	21	16	0.	208										
LINDSEY	03/13/86	7:30	13.5	7.1	6.2	23	20	0.	221										
LINDSEY	04/23/86	7:30	18.5	7.6	5.3	44	39	0.	387										
LINDSEY	05/28/86	6:00	20.	8.	6.	52	47	0.	528										
LINDSEY	06/25/86	6:35	21.5	8.	7.2	43	37	0.	461										
LINDSEY	07/23/86	6:35	20.5	7.7	7.4	38	33		431	7170	141	20	22	2.8	134	38	2.5	0.3	254
LINDSEY	08/27/86	6:45	20.5	7.6	6.7	46	42		514										
LINDSEY	09/09/86	6:35	18.5	7.8	7.6	42	39		466										
LINDSEY	11/05/86	9:15	14.5	7.5	8.5	44	44		490										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	Se mg/L	EC uS/cm	ASBEST MF/L	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
											<------				mg/L				------>
LINDSEY	12/03/86	8:25	9.5	7.5	9.5	48	43		496										
LINDSEY	01/08/87	8:30	7.5	7.3	10.1	44	46		492										
LINDSEY	02/05/87	8:50	10.	7.5	9.6	52	53		547			24	27	3.3					
LINDSEY	03/03/87	8:15	11.	8.	9.9	50	52		518										
LINDSEY	04/09/87	7:00	16.5	7.9	8.7	65	63		606										
LINDSEY	05/13/87	7:00	23.5	7.9	7.3	48	44		530										
LINDSEY	06/04/87	7:15	19.5	7.9	7.7	53	53		593										
LINDSEY	09/03/87	8:30	21.2	7.5	6.5														
LINDSEY	09/03/87	8:30	21.9	7.2	6.	41	36		460										
LINDSEY	10/08/87	11:55	20.	7.4	8.1														
LINDSEY	10/08/87	11:55	20.	7.4	8.1	39	36		523										
LINDSEY	11/03/87	8:25	15.5	7.6	8.2	48	43		513										
LINDSEY	12/01/87	8:30	10.9	7.4	9.7	46	46		509										
MALLARD	07/28/83	10:45	24.2	7.3	8.6	11	11		137										
MALLARD	08/25/83	9:50	21.	7.6	8.	21	27		216										
MALLARD	09/20/83	9:00	21.	7.3	7.7	15	16		181										
MALLARD	10/18/83	9:10	17.5	7.3	8.5	13	13		152	690									
MALLARD	11/21/83	10:05	12.5	7.2	9.5	15	16		180	1400									
MALLARD	12/28/83	9:30	10.	7.3	10.3	13	13		168	26000									
MALLARD	02/13/85	7:50	11.5	7.7	11.9	96	155	0.	749										
MALLARD	03/13/85	8:15	14.	8.4	13.5	320	558	0.	2160	1300									
MALLARD	04/10/85	7:30	16.	7.5	8.	348	569		2210										
MALLARDIS	05/08/85	7:00	16.	7.8	8.7	1740	2890	0.	9290										
MALLARDIS	05/29/85	8:35	17.	7.7	8.7	454	736		2720										
MALLARDIS	06/12/85	7:00	21.5	7.8	8.	469	840		2980										
MALLARDIS	08/14/85	7:30	19.	8.	8.5	1390	2510	0.	8480										
MALLARDIS	09/11/85	7:35	18.5	7.9	8.2	1230	2180	0.	7320										
MALLARDIS	10/09/85	7:35	17.	8.	8.4	980	1880	0.	6330										
MALLARDIS	11/19/85	10:15	11.5	8.1	9.6	2340	4260	0.	13100										
MALLARDIS	12/03/85	10:10	12.	7.5	9.9	1760	3130	0.	9970	240									
MALLARDIS	01/16/86	9:40	10.	7.7	10.2	2180	3540	0.	10700										
MALLARDIS	02/27/86	9:55	14.5	7.	8.8	12	12	0.	169		54	12	6	2.	43	18	5.8	0.1	102
MALLARDIS	03/13/86	11:30	13.	7.3	9.4	12	14	0.	161		50	10	6	1.8	42	18	2.6	0.1	108
MALLARDIS	04/23/86	9:15	16.5	7.3	8.9	20	23	0.	226		59	12	7	1.6	48	22	2.6	0.1	136
MALLARDIS	05/28/86	8:15	17.	7.6	8.6	680	1240	0.	4160		473	41	90	29.	65	192	1.4	0.4	2340
MALLARDIS	06/25/86	10:35	21.	7.7	8.1	689	1280	0.	4250		487	40	94	28.	65	197	0.9	0.4	2430
MALLARDIS	07/23/86	8:40	20.5	7.9	8.1	892	1630		5330	3490									
MALLARDIS	08/27/86	8:45	20.5	7.8	8.9	634	1140		3970		445	38	85	2.6	60	161	0.9	0.4	2180
MALLARDIS	09/09/86	8:15	18.5	7.9	8.7	1000	1840		6180		690	47	139	37.	67	266	2.	0.5	3730
MALLARDIS	11/05/86	11:45	17.5	7.7	9.5	699	1260		4550		479	35	95	30.	62	187	2.4	0.4	2520
MALLARDIS	12/03/86	11:45	13.	7.5	9.7	1180	2230		7330		834	70	160	53.	67	296	1.6	0.6	4300
MALLARDIS	01/08/87	11:45	9.	7.5	10.5	1260	2310		7800		831	59	166	53.	73	336	1.5	0.6	4500
MALLARDIS	02/05/87	11:30	11.	7.7	10.6	972	1710		5780		675	46	136	2.	83	289	1.8	0.5	3430
MALLARDIS	03/03/87	11:15	11.5	7.4	9.9	359	620		2280		268	28	48	15.	70	100	3.5	0.2	1190
MALLARDIS	04/09/87	10:00	18.	7.6	9.2	280	470		1780		225	24	40	12.	69	85	2.1	0.2	1030
MALLARDIS	05/13/87	9:30	23.	8.2	5.	1240	2250		7480		857	63	170	50.	76	317	1.6	0.7	4270
MALLARDIS	06/04/87	10:30	20.5	7.9	8.5	1980	3640		12000		1340	88	271	8.	78	497	1.1	1.	6850
MALLARDIS	10/08/87	8:15	20.8	7.9	7.4	2110	3960		12200		1350	91	273	79.	83	536	2.1	1.	7420

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4
MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<------------------------------mg/L------------------------------>								
MALLARDIS	10/08/87	8:15	20.8	7.9	7.4														
MALLARDIS	11/03/87	11:20	18.8	7.8	7.8	2370	4430		13700		1660	107	337	91.	82	666	1.7	1.1	8220
MALLARDIS	12/01/87	11:40	13.2	7.9	8.2														
MIDDLER	02/06/85	8:30	6.5	7.3	11.2	38	43	0.	391										
MIDDLER	03/06/85	9:00	10.	7.4	10.	31	34	0.	339	210									
MIDDLER	04/05/85	7:30	17.	7.5	8.9	40	40		378										
MIDDLER	05/01/85	6:50	19.	7.6	9.3	29	29	0.001	303										
MIDDLER	06/05/85	6:40	20.	7.8	9.	26	25		252										
MIDDLER	06/07/85	8:05	23.5	7.7	8.9	23	25		256										
MIDDLER	08/01/85	7:00	22.	7.4	7.8	35	46	0.	331										
MIDDLER	10/23/85	11:15	18.	7.5	9.4	40	61	0.	396										
MIDDLER	12/03/85	12:15	11.5	7.4	10.3	54	83	0.	464	100									
MIDDLER	03/11/86	10:30	14.5	7.3	8.2	30	38	0.001	343										
MIDDLER	04/17/86	7:30	14.	7.3	8.8	20	26	0.001	213										
MIDDLER	05/13/86	8:30	19.5	7.3	8.1	26	30	0.	270										
MIDDLER	06/11/86	6:15	22.5	7.3	7.8	28	34	0.	272										
MIDDLER	07/09/86	6:30	23.5	7.3	7.7	24	26		263	540									
MIDDLER	08/13/86	6:30	23.	7.3	7.3	24	27		260										
MIDDLER	09/11/86	6:30	21.5	7.3	7.5	26	30		284										
MIDDLER	11/19/86	11:55	14.5	7.4	9.1	20	24		230										
MIDDLER	12/10/86	12:50	10.	7.2	9.6	26	25		255										
MIDDLER	01/13/87	12:15	8.5	7.3	10.	31	39		333										
MIDDLER	02/10/87	11:45	11.5	7.2	9.8	36	46		384										
MIDDLER	03/10/87	12:00	13.5	7.1	8.8	43	52		436										
MIDDLER	04/16/87	10:00	20.	7.2	7.8	40	50		440										
MIDDLER	05/20/87	9:30	21.5	7.2	6.8	25	32		293										
MIDDLER	06/11/87	10:45	23.	6.9	8.9	39	51		404										
MIDDLER	09/24/87	10:00	21.6	7.3	7.1														
MIDDLER	09/24/87	10:00	20.8	7.3	7.4	59	83		603										
MIDDLER	10/28/87	10:15	20.5	7.3	7.3														
MIDDLER	10/28/87	10:15	20.5	7.3	7.3	69	97		565										
MIDDLER	11/24/87	11:45	14.5	7.2	8.5														
MIDDLER	12/16/87	7:50	10.2	7.3	12.														
MOKELUMNE	07/21/83	7:15	18.	7.2	9.6	2	1		34										
MOKELUMNE	08/18/83	8:00	19.	6.6	9.2	2	1		34										
MOKELUMNE	09/13/83	7:50	19.	7.1	8.8	2	1		33										
MOKELUMNE	10/04/83	8:15	17.5	6.8	9.5	2	1		32	17									
MOKELUMNE	11/01/83	7:50	16.5	6.6	8.3	1	1		31	31									
MOKELUMNE	12/06/83	7:40	12.	6.8	10.4	2	1		38	200									
MOKELUMNE	01/10/84	9:25	10.5	6.9	11.	2	1		42	170									
MOKELUMNE	02/01/84	8:50	9.5	6.7	11.2	2	1		44	32									
MOKELUMNE	03/07/84	8:30	11.	7.2	11.5	2	1		45	26									
MOKELUMNE	04/04/84	7:35	13.	7.3	10.9	2	1		47	44									
MOKELUMNE	05/02/84	6:25	14.	7.2	10.7	2	1		46	10									
MOKELUMNE	06/06/84	8:25	15.5	7.3	10.2	2	1		47	53									
MOKELUMNE	07/10/84	7:55	17.5	7.3	9.5	2	1		48	12									
MOKELUMNE	08/01/84	8:20	23.5	7.2	9.5	2	1		47										
MOKELUMNE	09/05/84	7:20	18.5	7.3	9.3	2	1		48										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	Se mg/L	EC uS/cm	ASBEST MF/L	HARD mg/L	Ca mg/L	Mg mg/L	K mg/L	ALK mg/L	SO4 mg/L	NO3 mg/L	B mg/L	TDS mg/L
MOKELUMNE	10/04/84	9:15	17.5	7.2	9.4	2	1		44										
MOKELUMNE	11/08/84	9:20	16.	7.	9.6	2	1		45										
MOKELUMNE	12/05/84	9:45	12.	7.2	10.9	2	2		46	19									
NATOMAS	08/26/87	0:00																	
NATOMAS	09/24/87	7:00	18.2	7.4	5.7														
NATOMAS	09/24/87	7:00	18.2	7.4	5.7	44	43		614		203	35	28	1.	196	28	5.4	0.1	330
NATOMAS	10/28/87	7:20	19.5	7.3	5.5	24	26		334		103	18	14	1.	104	20	5.8	0.1	205
NATOMAS	10/28/87	7:20	19.5	7.3	5.5														
NATOMAS	11/24/87	7:45	11.7	8.	6.6														
NATOMAS	12/16/87	10:30	7.7	7.5	10.3														
NOBAY	07/28/83	8:30	21.	7.9	9.	10	5		301										
NOBAY	08/25/83	7:25	19.	8.5	8.9	10	5		301										
NOBAY	09/20/83	11:20	20.	7.6	9.7	9	5		301										
NOBAY	10/18/83	7:20	17.	8.9	9.5	10	5		298	200									
NOBAY	11/21/83	8:45	11.	7.8	10.4	11	7		312	1600									
NOBAY	12/28/83	8:15	11.5	7.6	10.2	11	6		279	6000									
NOBAY	01/31/84	8:50	11.5	8.2	11.3	12	7		322	2600									
NOBAY	02/22/84	9:25	12.	8.2	10.7	12	6		314	2900									
NOBAY	03/14/84	8:50	16.	8.3	8.2	13	6		333	1500									
NOBAY	04/11/84	8:40	15.	8.4	10.4	10	6		310	2000									
NOBAY	05/23/84	9:25	20.	8.4	9.3	10	5		312	370									
NOBAY	06/13/84	6:40	17.5	8.5	9.5	9	5		306	1100									
NOBAY	07/11/84	7:35	19.5	7.5	9.1	9	5		308	1200									
NOBAY	08/22/84	9:17	19.	8.4	9.2	10	5		314										
NOBAY	09/12/84	9:30	19.5	8.4	9.	9	5		321										
NOBAY	10/11/84	8:15	18.	8.2	9.1	9	5		312										
NOBAY	11/15/84	8:45	13.	8.	9.4	10	6		296										
NOBAY	12/06/84	8:25	10.5	8.1	10.1	15	10		339	1600									
NOBAY	02/13/85	9:20	10.5	8.	8.7	18	10	0.	321										
NOBAY	03/13/85	9:30	13.	8.3	10.	13	8	0.	350	1100									
NOBAY	04/10/85	8:30	17.5	8.4	9.5	14	8		371										
NOBAY	05/08/85	8:30	16.	8.1	9.8	11	5	0.	334										
NOBAY	06/12/85	8:45	20.	8.2	9.2	10	5		325										
NOBAY	08/14/85	9:00	18.	8.3	10.1	10	5		336										
NOBAY	10/09/85	9:00	16.	8.3	9.7	9	5	0.001	330										
NOBAY	12/03/85	8:40	11.5	8.	10.3	10	6	0.	320	430									
NOBAY	03/13/86	9:15	14.	8.	9.5	11	6	0.	278										
NOBAY	04/23/86	10:45	18.	8.2	9.1	13	7	0.	336										
NOBAY	05/28/86	9:45	19.5	8.3	9.6	10	5	0.	306										
NOBAY	06/25/86	8:45	19.	8.3	9.2	9	5	0.	293										
NOBAY	07/23/86	12:00	19.	8.4	8.9	9	5		296	1090									
NOBAY	08/27/86	10:15	18.5	8.3	9.6	9	6		298										
NOBAY	09/09/86	9:50	18.5	8.2	9.2	8	5		286										
NOBAY	11/05/86	7:45	13.5	8.2	9.6	10	6		299										
NOBAY	12/03/86	10:20	10.5	8.2	11.2	10	5		293										
NOBAY	01/08/87	10:25	9.	8.	11.5	8	4		301										
NOBAY	02/05/87	10:00	11.5	8.2	11.	10	6		316										
NOBAY	03/03/87	9:45	12.	8.4	11.2	9	6		331										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4

MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<----------				-mg/L-				---------->
NOBAY	04/09/87	8:30	17.5	8.5	9.8	11	6		322										
NOBAY	05/13/87	8:00	20.	8.1	9.	9	5		327										
NOBAY	06/04/87	8:30	18.	8.3	9.3	9	5		328										
NOBAY	09/03/87	0:00																	
NOBAY	09/03/87	6:55	18.8	7.5	9.8	10	5		309										
NOBAY	10/08/87	9:30	17.1	8.4	9.6	10	7		353										
NOBAY	10/08/87	9:30	17.1	8.4	9.6														
NOBAY	11/03/87	9:45	14.5	8.1	10.1	9	5		313										
NOBAY	12/01/87	10:15	11.9	8.1	10.1	9	6		310										
ROCKSL	07/26/83	12:40	23.	7.	7.	15	16		158										
ROCKSL	08/23/83	11:00	24.5	7.2	6.9	15	14		171										
ROCKSL	09/14/83	11:45	25.	7.1	6.1	26	29		254										
ROCKSL	10/12/83	10:05	21.	7.1	7.7	17	21		177	950									
ROCKSL	11/08/83	10:30	17.	7.2	8.4	22	23		224	570									
ROCKSL	12/13/83	12:20	12.	6.9	9.8	20	21		202	560									
ROCKSL	01/24/84	10:25	10.	7.3	10.8	25	25		248	500									
ROCKSL	02/28/84	12:05	13.5	7.5	10.	32	35		316	500									
ROCKSL	03/27/84	10:30	16.5	7.5	9.8	22	24		254	480									
ROCKSL	04/25/84	11:35	16.5	7.3	9.6	15	14		193	1100									
ROCKSL	05/30/84	9:05	24.	7.5	8.1	15	15		194	140									
ROCKSL	06/27/84	10:50	26.	7.2	6.8	16	15		189	430									
ROCKSL	07/25/84	10:45	24.	7.7	8.1	22	27		217	600									
ROCKSL	08/29/84	9:00	24.	7.4	8.2	21	26		221										
ROCKSL	09/27/84	11:30	23.	7.8	8.3	16	14		199										
ROCKSL	10/25/84	11:30	17.	8.	10.9	16	15		194										
ROCKSL	11/29/84	13:30	12.	7.4	10.5	14	13		186										
ROCKSL	12/12/84	11:45	11.	7.3	9.7	14	13		195	540									
ROCKSL	01/30/85	10:15	8.	7.2	10.8	22	24	0.001	284										
ROCKSL	02/27/85	11:45	14.	7.5	10.3	21	21	0.	258										
ROCKSL	03/27/85	11:15	12.	7.4	10.1	24	25	0.	269	590									
ROCKSL	04/24/85	11:23	18.	7.8	10.1	21	18	0.	232										
ROCKSL	05/22/85	10:20	21.5	8.2	9.2	21	24	0.	225										
ROCKSL	06/07/85	9:30	23.	7.9	9.1	25	30		252										
ROCKSL	06/26/85	10:00	23.	7.6	8.	41	56	0.	360										
ROCKSL	07/10/85	9:55	25.	7.3	7.6	60	81	0.	453										
ROCKSL	08/28/85	10:45	23.5	7.6	8.1	81	122	0.	630										
ROCKSL	09/25/85	10:32	22.5	7.6	8.1	101	164	0.	776										
ROCKSL	10/23/85	10:15	17.5	7.8	10.	99	158	0.	738										
ROCKSL	11/15/85	11:40	12.5	7.5	10.4	135	238	0.	988										
ROCKSL	12/03/85	11:25	11.5	7.4	10.5	133	228	0.	965	260									
ROCKSL	01/23/86	11:45	11.	7.3	9.6	66	85	0.	476										
ROCKSL	02/13/86	10:45	11.5	7.4	10.2	36	50	0.	319										
ROCKSL	03/04/86	11:40	17.5	7.3	6.2	32	35	0.	342										
ROCKSL	04/09/86	12:15	17.	7.3	8.5	29	31	0.	262										
ROCKSL	05/07/86	9:45	17.	7.2	7.4	21	23		227										
ROCKSL	06/04/86	10:40	22.5	7.3	7.6	19	21	0.	225										
ROCKSL	07/02/86	10:00	25.5	7.3	6.3	19	19		225	740	66	13	8	1.9	56	21	1.	0.1	144
ROCKSL	08/14/86	11:00	23.5	7.5	8.1	21	26		219										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4
MINERAL DATA REPORT

STATION	DATE	TIME	TEMP	PH	DO	NA	CL	Se	EC	ASBEST	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
			oC		mg/L	mg/L	mg/L	mg/L	uS/cm	MF/L	<-------				mg/L				------->
ROCKSL	09/24/86	10:25	20.	7.5	8.1	49	31		285		82	18	9	1.9	68	34	7.6	0.2	196
ROCKSL	11/12/86	11:15	14.5	7.3	9.4	13	14		180										
ROCKSL	12/17/86	7:50	10.	7.3	9.5	25	36		272										
ROCKSL	01/22/87	7:40	6.5	7.3	11.8	24	30		268										
ROCKSL	02/24/87	7:45	11.	7.3	10.5	30	41		355										
ROCKSL	03/24/87	7:45	13.	7.3	10.2	25	30		302										
ROCKSL	04/30/87	6:30	19.5	8.3	9.81	25	28		314										
ROCKSL	05/28/87	9:30	20.5	7.3	7.3														
ROCKSL	06/23/87	9:45	23.5	7.3	7.3	54	87		488										
ROCKSL	09/09/87	0:00	22.6	7.4	9.1														
ROCKSL	09/09/87	10:15	22.6	7.4	9.1	125	210		923										
ROCKSL	10/22/87	10:00	19.	7.4	8.2	119	201		872										
ROCKSL	10/22/87	9:30	19.	7.4	8.3														
ROCKSL	11/05/87	11:15	17.5	7.3	8.9	73	116		617										
ROCKSL	12/08/87	10:45	11.3	7.3	10.1	154	277		1140										
VERNALIS	07/26/83	8:15	20.	7.3	7.7	29	30		288										
VERNALIS	08/23/83	7:00	20.	7.2	8.	23	24		247										
VERNALIS	09/14/83	7:15	20.	7.4	8.2	15	14		158										
VERNALIS	10/12/83	6:25	17.5	7.1	8.5	11	11		126	780									
VERNALIS	11/08/83	7:30	15.	7.3	8.2	39	38		381	1300									
VERNALIS	12/13/83	8:25	11.	7.1	10.	14	13		155	740									
VERNALIS	01/24/84	7:35	10.	7.	10.	21	19		210	870									
VERNALIS	02/28/84	8:15	12.	7.5	9.7	38	39		352	270									
VERNALIS	03/27/84	7:20	14.5	7.3	9.4	48	52		464	1800									
VERNALIS	04/25/84	7:55	14.	7.3	8.8	59	66		547	1700									
VERNALIS	05/30/84	6:20	24.5	7.9	7.3	69	80		629	1300									
VERNALIS	06/27/84	6:50	25.5	7.3	6.3	77	88		694	1300									
VERNALIS	07/25/84	7:05	23.	7.5	6.5		92	0.001	640	3300									
VERNALIS	08/29/84	6:20	24.	7.6	7.1	58	62		549										
VERNALIS	09/27/84	7:25	20.	7.4	8.3	39	43	0.	388										
VERNALIS	10/25/84	8:10	15.5	7.4	7.9	39	41	0.	378										
VERNALIS	11/29/84	9:40	11.5	7.1	9.2	43	44	0.	400										
VERNALIS	12/12/84	8:30	11.	7.3	9.2	34	32	0.	324	510									
VERNALIS	01/30/85	7:50	8.	7.4	10.5	54	55	0.001	483										
VERNALIS	02/22/85	13:10	12.	7.4	6.4	75	69	0.001	598										
VERNALIS	02/27/85	8:15	12.5	7.4	9.6	70	73	0.002	629										
VERNALIS	03/27/85	8:45	12.	7.4	9.	92	97	0.002	801	810									
VERNALIS	04/24/85	7:45	17.	7.4	7.9	87	80	0.002	667										
VERNALIS	05/22/85	7:00	20.5	7.4	7.2	84	99	0.002	756										
VERNALIS	05/29/85	6:45	18.	7.7	7.9	89	98		774										
VERNALIS	06/26/85	6:45	23.	7.5	7.3	81	94	0.001	717										
VERNALIS	07/10/85	6:45	22.5	7.4	7.1	55	58	0.001	490										
VERNALIS	08/28/85	7:15	19.5	7.7	7.4	52	60	0.001	487										
VERNALIS	09/25/85	7:07	21.5	7.4	6.8	59	70	0.	563										
VERNALIS	10/23/85	7:00	15.5	7.4	7.4	53	65	0.	519										
VERNALIS	11/15/85	8:20	8.5	7.5	9.7	80	94	0.001	706										
VERNALIS	12/03/85	15:30	13.5	7.4	8.9	66	74	0.001	604	560									
VERNALIS	01/23/86	7:45	12.	7.5	8.8	99	107	0.	790										

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

TABLE G-4
MINERAL DATA REPORT

STATION	DATE	TIME	TEMP oC	PH	DO mg/L	NA mg/L	CL mg/L	Se mg/L	EC uS/cm	ASBEST MF/L	HARD	Ca	Mg	K	ALK	SO4	NO3	B	TDS
											<------------------------mg/L------------------>								
VERNALIS	02/13/86	7:30	11.5	7.3	9.	82	86	0.002	686										
VERNALIS	03/04/86	8:00	15.	7.3	8.3	28	26	0.001	268		60	14	6	1.9	50	38	2.6	0.2	166
VERNALIS	04/09/86	8:00	15.	7.3	9.2	18	18	0.	169		45	10	5	1.5	39	24	1.5	0.1	114
VERNALIS	05/07/86	6:30	14.5	7.3	8.8	27	27	0.001	257		66	15	7	1.8	54	37	4.9	0.2	168
VERNALIS	06/04/86	7:45	20.5	7.3	8.	26	28	0.001	254		66	15	7	1.6	49	37	3.3	0.2	160
VERNALIS	07/02/86	6:50	23.	7.5	7.9	65	75		595	900	144	31	16	3.	90	82	5.6	0.3	390
VERNALIS	08/14/86	7:15	21.5	7.6	7.6	60	67	0.001	557		134	29	15	2.6	89	76	6.4	0.4	328
VERNALIS	09/24/86	7:00	17.5	7.3	8.2	32	34	0.	317										
VERNALIS	11/12/86	7:45	13.5	7.3	9.7	47	55	0.001	447		102	21	12	1.8	73	59	7.4	0.2	268
VERNALIS	12/17/86	11:30	11.5	7.3	10.5	34	37	0.	331		74	15	9	1.5	52	40	1.7	0.2	195
VERNALIS	01/22/87	11:20	8.5	7.3	11.1	73	88	0.	679		148	31	17	2.7	93	100	9.9	0.4	415
VERNALIS	02/24/87	11:15	11.5	7.5	9.9	93	105	0.003	868		180	39	20	3.4	99	142	9.3	0.6	514
VERNALIS	03/24/87	10:45	13.	7.3	9.6	100	105	0.003	831		198	43	22	0.8	107	152	9.6	0.7	530
VERNALIS	04/30/87	9:45	19.	7.3	8.4	59	74	0.001	564		139	29	16	3.	87	73	5.9	0.3	349
VERNALIS	05/28/87	6:45	18.	7.4	8.2	66	77		622		150	32	17	2.9	93	72	6.4	0.4	363
VERNALIS	06/23/87	7:15	22.5	7.7	4.6	88	104		807		181	36	22	3.3	112	114	9.2	0.5	455
VERNALIS	06/23/87	7:15	22.5	7.7	4.6			0.002											
VERNALIS	06/24/87	8:30	23.	7.5	1.9														
VERNALIS	08/25/87	0:00																	
VERNALIS	09/09/87	7:00	21.5	6.8	7.2														
VERNALIS	09/09/87	7:00	21.5	6.8	7.2	81	99	0.001	734		175	37	20	3.	111	88	7.6	0.4	439
VERNALIS	10/22/87	6:50	18.5	7.4	8.2	91	117		807		181	36	22	3.	123	81	7.1	0.3	476
VERNALIS	10/22/87	6:50	18.5	7.4	8.2														
VERNALIS	11/05/87	7:20	15.	7.6	8.7	118	142		951		228	47	27	1.	135	120	7.7	0.6	584
VERNALIS	12/08/87	8:00	13.6	7.4	9.4														

Note: Negative values signify reporting limits. Concentration of analyte below reporting limit.

Appendix H
DAYFLOW MODEL DESCRIPTION

DAYFLOW is a computer program developed in 1978 as an accounting tool for determining historical Delta boundary hydrology. DAYFLOW output is used extensively in studies initiated by the Department of Water Resources, the Department of Fish and Game, other State and Federal agencies, and private consultants. Output has been put in STORET, the Environmental Protection Agency's data storage and retrieval system, making it available for use nationally.

At this time, the DAYFLOW program provides the best estimate of historical mean daily flows:

- Through the Delta Cross Channel and Georgiana Slough;

- Past Jersey Point; and

- Past Chipps Island to San Francisco Bay (net Delta outflow).

The degree of accuracy of DAYFLOW output is affected by the DAYFLOW computational scheme and accuracy and limitations of the input data. Input data include the principal Delta stream inflows, Delta precipitation, Delta exports, and Delta gross channel depletions. These data include both monitored and estimated values. Currently, flows are not routed to account for travel time through the Delta. All calculations involving inflows, depletions, transfers, exports, and outflow are performed using data for the same day.

Computational Scheme

The DAYFLOW computational scheme was developed to derive three types of quantities:

- Net Delta outflow estimates at Chipps Island.

- Interior Delta flow estimates at significant locations.

- Summary and fish-related parameters and indices.

Net Delta Outflow Estimates at Chipps Island

Net Delta outflow at Chipps Island is estimated by performing a water balance around the boundary of the Sacramento-San Joaquin Delta, taking Chipps Island as the western limit. (This quantity should not be confused with the total tidal flow, which is much larger.) A flow schematic is shown in Figure H-1. In its most general form, using DAYFLOW parameters, the water balance equation is (see Table H-1 for definitions of DAYFLOW parameters):

$$QOUT = QTOT + QPREC - QDEPL - QEXP$$

Where:

QOUT = Net Delta outflow at Chipps Island
QTOT = Total Delta inflow
QPREC = Delta precipitation runoff estimate
QDEPL = Deltawide gross channel depletion estimate (consumptive use)
QEXP = Total Delta exports and diversions/transfers

The parameters on the right side of the equation are input data used to calculate net Delta outflow.

Total Delta Inflow (QTOT): The principal surface water inflows, miscellaneous streamflows, and Yolo Bypass flow addition near Rio Vista are included in determination of total Delta inflow according to the following equation:

$$QTOT = QSAC + QEAST + QYOLO$$

Eastern Delta inflow (QEAST) includes inflow to the Delta from the northeast, east, and southeast (Marsh Creek is the exception, flowing to the Delta from the southwest). QEAST is defined as:

$$QEAST = QSJR + QCRM + QMOKE + QMISC$$

Miscellaneous streamflow (QMISC) is a composite flow defined as:

QMISC = Calaveras River flow +
Bear Creek flow +
Dry Creek flow +
Stockton Diverting Canal flow +
French Camp Slough flow +
Marsh Creek flow +
Morrison Creek flow

The Yolo Bypass flow addition to the Delta water balance is calculated as:

QYOLO = Yolo Bypass flow at Woodland +
Sacramento Weir Spill +
South Fork Putah Creek

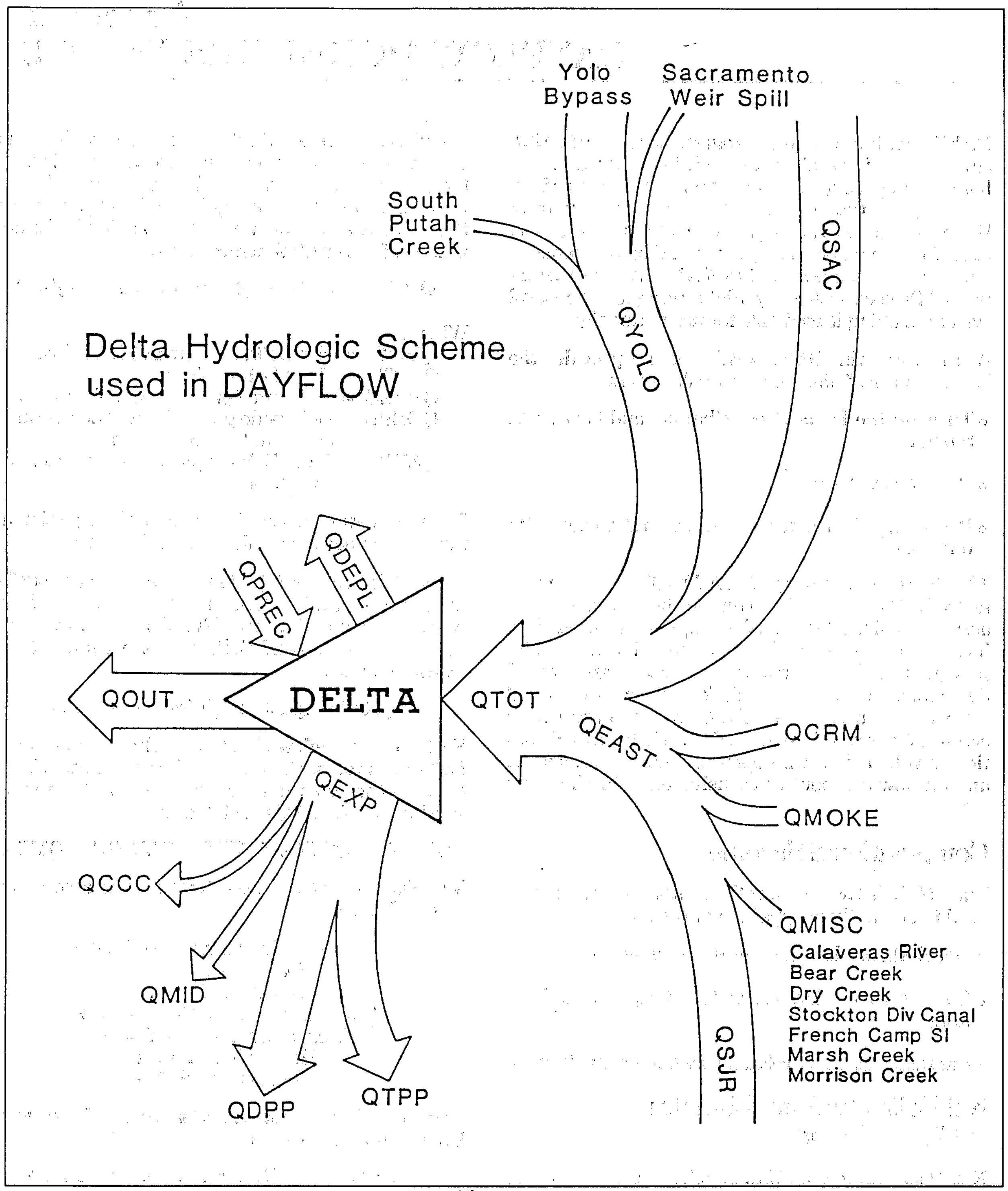

Figure H-1
DELTA HYDROLOGIC SCHEME USED IN DAYFLOW

Table H-1
LISTING OF DAYFLOW PARAMETERS

Column Number*	DAYFLOW Parameter	Description	Pre-Execution Calculation	DAYFLOW Program Calculation	Comments
(1)	QSJAR	San Joaquin River at Vernalis	None	None	Measured
(2)	QCRM	Cosumnes River at Michigan Bar	None	None	Measured
(3)	QMOKE	Mokelumne River at Woodbridge	None	None	Measured
(4)	QMISC	Miscellaneous Stream Flow	Sum of Calaveras River, Bear Creek, Marsh Creek, Dry Creek, Stockton Diversion Canal, Morrison Creek, and French Camp Slough	None	Sum of Measured Flows; Hand Calculated or Intermediate Program Used (e.g. DFDAT84)
(5)	QEAST	East Delta Inflow	None	Sum of Flows (1) through (4)	Calculated
(6)	QSAC	Sacramento River at Freeport	None	None	Measured
(7)	QYOLO	Yolo Bypass Flow	Sum of Yolo Bypass near Woodland, Sacramento Weir Spill, and South Fork Putah Creek	None	Sum of Measured Flows; Hand Calculated or Intermediate Program Used (e.g. DFDAT84)
(8)	QTOT	Total Inflow	None	Sum of Flows (5) through (7)	Calculated
(9)	QDEPL	Gross Channel Depletion	None	None	Estimated by DWR (1965); Repeating Annual Cycle
(10)	QPREC	Delta Precipitation Runoff	Depth Converted to Volume; Evenly Distributed Over 5 Days from Event	None	Measured Precipitation; Estimated Runoff Pattern (5-Day)
(11)	QCD	Net Channel Depletion	None	Depl (9) —Flow (10)	Calculated
(12)	QTPP	CVP Tracy Export	None	None	Operations Records
(13)	QDPP	SWP Export	Byron Bethany ID Pumping Subtracted (From 5/1/71)	None	Operations Records; Delta PP through 4/30/71, Clifton Court Intake from 5/1/71.
(14)	QCCC	Contra Costa Canal Export	None	None	Operations Records
(15)	QMID	Miscellaneous Diversions	Determine Intensity and Duration of Event	None	Estimated Diversions and Transfers (e.g. Island Flooding and Pumping)
(16)	QEXP	Total Exports	None	Sum of Exports (12) through (15)	Calculated
(17)	QXGEO	Delta Cross Channel and Georgiana Slough	Gate Operation Code and Partial Settings Determined	Calculated by Emperical Formula Based on Gate Settings and Sacramento River Flow	Estimated; Times Determined and Operations Coded by Hand
(18)	QWEST	Flow Past Jersey Point	None	Flow (5) +Flow (17) — Exports (16) —65% Depletion (11)	Calculated
(19)	QOUT	Delta Outflow at Chipps Island	None	Flow (8) —Depletion (11) — Exports (16)	Calculated
(20)	QDIVER	Percent Diverted	None	[Exports (16) +Depletion (11)] / Flow (8)	Calculated
(21)	QEFFECT	Effective Inflow	None	A. If [Exp (16) + 42% Depl (11)] >= Flow (1), Then Flow (21) = Flow (8) — Flow (1) B. If [Exp (16) + 42% Depl (11)] < Flow (1), Then Flow (21) = Flow (8) —Lower [(65% Flow (1) +15% Depl (11)) **OR** (Exp (16) +42% Depl (11))]	Calculated
(22)	QEFFDIV	Effective Percent Diverted	None	[Flow (21) —Flow (19)] / Flow (21)	Calculated

* Column numbers refer to DAYFLOW Data Summary Report Layout.